THE ILLUMINATING ENGINEER

LIGHT
LAMPS
FITTINGS
AND
ILLUMINATION

THE JOURNAL OF
GOOD LIGHTING

Official Organ of the Illuminating Engineering Society

FOUNDED IN LONDON 1908

Edited by
J. STEWART DOW

OIL
GAS
ELECTRICITY
ACETYLENE
PETROL-AIR
GAS
ETC.

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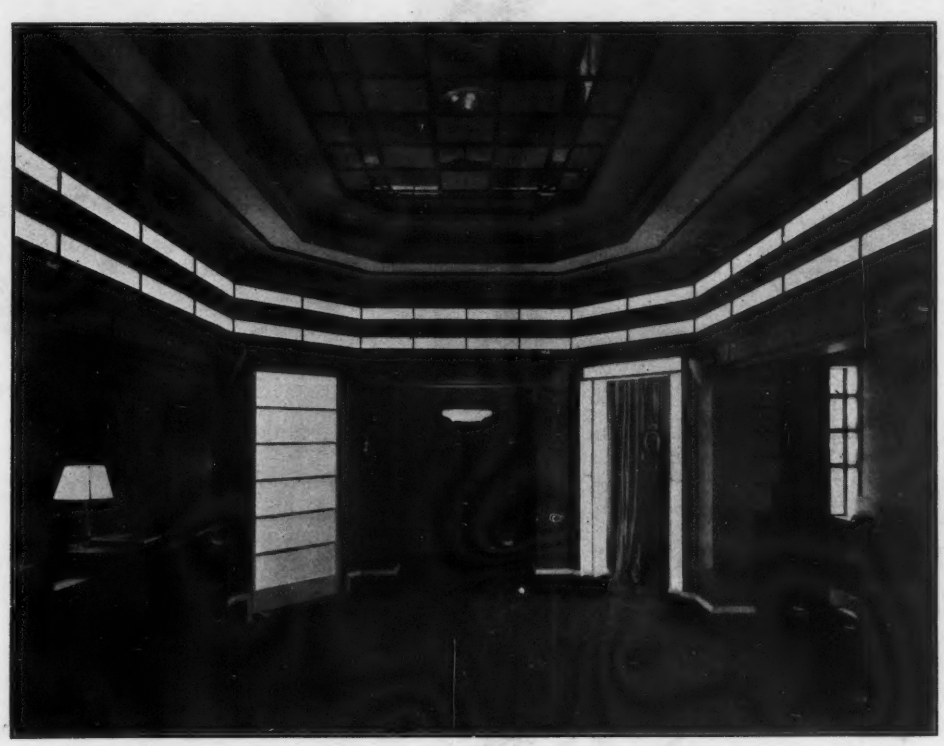
Special Features:

The chief feature of this number is the illustrated account of the discussion on **"Problems in Illuminating Engineering,"** which took place before the Illuminating Engineering Society, on December 10th, 1929. Various novel and striking lighting installations are described.

ARCHITECTURAL LIGHTING



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No. 4

Exterior view of a loading bank lighted by 14 gas lamps with superheated clusters of three No. 2 mantles. The bays, of which there are 14, will accommodate 28 lorries. The light is adequate not only for loading, but for checkers to make their notes. The lamps are specially designed for positions where immunity from wind and weather is essential. On the evening when the photograph was taken there was a moderate wind, but the lights remained absolutely steady. Each lamp has a lever cock and flashing by-pass, and is separately controlled. Individual bays can, of course, be lighted up separately when the whole series is not in use at once.

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Problems in Illuminating Engineering

THE idea of devoting one evening to a series of short contributions on " Problems in Illuminating Engineering " was introduced by the Illuminating Engineering Society only a few years ago. It was undoubtedly a happy one, and these evenings have invariably been among the most interesting of the session. The variety of subjects in itself helps to sustain interest, and a meeting of this kind offers opportunities to those who may have something interesting to tell but who do not wish to commit themselves to the task of preparing a formal paper.

The meeting held on December 10th was, we think, quite as successful as its predecessors. Some charming illustrations showing the new lighting of the Savoy Theatre were contributed by Professor Robertson and Mr. B. Ionides. The methods adopted are quite in line with the tendency described as " architectural lighting," but the originators have shown more restraint and constructive skill than has been exhibited in some other attempts of this kind. Other examples of modern lighting were given by Mr. S. G. Elliot, who once more helped towards the success of a " problems " meeting. Although the examples were taken from the Underground Railway system, the methods might well be applied in many types of modern offices. It will be observed that here, too, the lighting, whilst quite practical, approaches the architectural style. Perhaps one of the neatest bits of work described was the system of illuminating counters of information offices by means of overhead diffusing panels—an idea that has also been carried into effect in the design of some of the main doorways giving entrance to the building. This is an excellent example of the idea of embodying lighting elements in the structure of a building —an idea that can naturally only be fully exploited when architect and lighting expert work together in the early stages of the design.

Mr. F. C. Smith's description of the lighting of the large sign outside Watson House was instructive as an instance of successful concealed lighting with gas, and other examples of the lighting of extensive display areas were given by Mr. Cunnington. The contributions mentioned above, whilst illustrating the solution of a number of problems, may be regarded mainly as exemplifying the latest tendencies in illumination. Mr. Cunnington's contribution, on the other hand, was concerned with one particular problem that is undoubtedly extremely difficult to solve. He commented upon various inherent difficulties in lighting large display signs and hoardings, such as the provision of even illumination, the avoidance of direct reflection from glazed and shiny surfaces, and the mounting of lighting equipment in such a manner as to be neither inaccessible nor unsightly. These difficulties may be partially overcome by skilful design. We think, however, that most people would agree with him that the ideal solution demands a different method, i.e., illumination by transmitted rather than reflected light. This method may not always be practicable and in some cases may involve higher initial cost. But there can be no question of the greater economy and more perfect results. We anticipate, therefore, that in future more general use will be made of this method, especially for signs or notices of a permanent character, which can be incorporated in the structure of the building with which they are associated.

We have left to the last Mr. Stallan's contribution, which in some ways was the most perfect example of a lighting problem and its solution. The provision of adequate illumination in motor-buses has always been a task of exceptional difficulty. To the ordinary difficulties of lighting installations are added various special ones, such as those arising from the limited overhead space and the restricted supply of energy—for a bus must generate and supply energy for its own lighting. Mr. Stallan contributed an instructive survey of the gradual introduction of better methods, including the provision of more satisfactory generating equipment. The company with which he is associated was quick to realize the drawback of glare from unshaded lights and the advantages of lamps with opal bulbs. By the courtesy of the London General Omnibus Co. Ltd. members were afforded an opportunity of inspecting the very latest design of bus, in which lamps are mounted behind curved panels of diffusing celluloid. The introduction of this idea has involved much careful research, especially in regard to the quality of celulloid used. The idea offers yet another illustration of the general tendency towards the use of extensive surfaces of low luminosity and the elimination of glare.

The chief impression one receives from a discussion of this kind is that the majority of light problems in illuminating engineering depend for their solution on skilful direction of light. This applies even to problems in which decorative effect is the main consideration. Fortunately the range of lighting units and apparatus available is now far wider than a few years ago, and devices can be procured to satisfy almost any need.

Opportunities for Light during the Christmas Season

PERHAPS we may be allowed to commence this note by expressing the hope that our readers have had a merry Christmas, and wishing them a happy new year. Joyous festivals, such as Christmas is intended to be, have always been associated with light. The rather dismal weather and the meagre natural light experienced by the writer and probably many others over Christmas tends to emphasize the possibilities of artificial light during this period.

Inclement weather conditions enhance the value of cheerful lighting in the home. It has often struck us that more might be done to encourage the habit of including pleasing designs of lamps and fittings amongst Christmas gifts. In the case of most trades an organized effort to bring their goods into the Christmas programme is made. One is somewhat inclined to doubt whether the sale of lighting appliances during the pre-Christmas weeks is pushed as it might be.

Perhaps one reason is that lamps and fittings are still regarded as too strictly utilitarian. Another factor is doubtless lack of technical knowledge on the part of the purchaser, including, in the case of electric light, uncertainty as to the pressure available in the homes of those for whom gifts are being considered. Perhaps an even more important factor is that lighting fittings are assumed to be part of the permanent equipment of the home; to present lighting fittings is, to some, as audacious as to offer a new variety of wallpaper!

Most of these considerations, however, have less weight than in the past. The design of more varied and decorative lighting devices, with distinctive charm, renders them more acceptable as a Christmas gift. Technical knowledge is becoming more general than it used to be. Even the vexation of varying pressures in different districts seems likely to be smoothed away by degrees. The tendency to more liberal supply of plugs and outlets and the encouragement of supplementary portable decorative lighting units as a supplement to the permanent lighting offer new opportunities to the giver. Some of the charming little luminous objects which serve as decorations rather than as illuminating devices make pleasing gifts. Furthermore, why should not householders be encouraged to adopt special decorative lighting during the Christmas season, as is not unusual in the United States, where groups of people even combine to make their street more cheerfully lighted? In that country the wax candle has come to be regarded by the child of to-day as a mildly interesting but obsolete firework. Christmas trees are lighted by electricity, and the sales of special coloured lamps for the purpose reach remarkable figures.

The chief effort towards festive lighting, undoubtedly, is made in the large stores, where considerable ingenuity is often shown. One would think that, once in the year, even local authorities might be inspired to do something to brighten their streets. The festivals of light occasionally undertaken in Continental cities have proved a success, benefiting not only concerns interested in lighting but trade generally. We commend the idea to makers of lamps and fittings and undertakings interested in the supply of gas and electricity. Could they not conspire to make Christmas a permanent "festival of light"?

Further Experiments on the Use of Special Spectacles in Very Fine Processes*

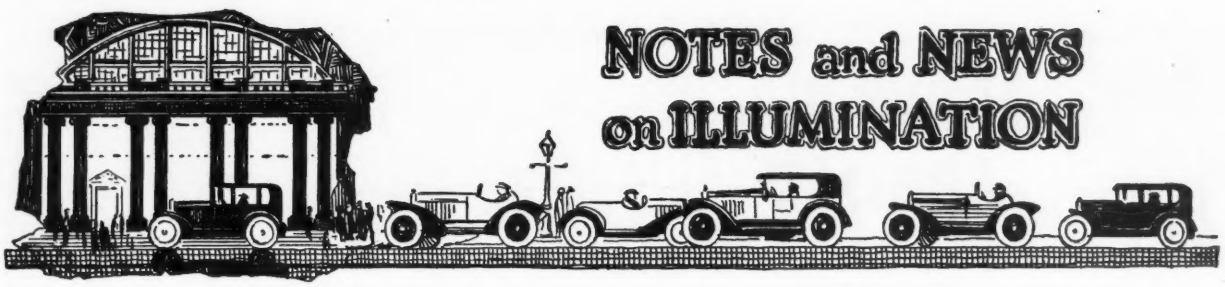
WE have previously drawn attention to the importance of the series of experiments conducted by Messrs. H. C. Weston and S. Adams on the use of special spectacles in certain industries involving very close work. To the illuminating engineer these researches are important because they show that there are certain "difficulties in seeing" that can only be put right by aiding the eye-lens; no increase in illumination can take the place of these remedial measures. It is not unusual for workers to complain of the lighting conditions when it is really their own eyes that are at fault. Unless the eye is capable of maintaining focus on minute objects in comfort it cannot see them with sustained clearness, however high the illumination may be.

In previous investigations the authors have shown the benefit of high-power glasses in a number of industries; for example, in hosiery linking, in mounting filaments, etc. But some uncertainty existed on one point—whether this benefit is confined to workers with defective vision or whether it applies also to persons whose eyes are normal. The present series of experiments sets that doubt at rest. Whilst the advantage derived from the use of such spectacles is most evident where previous visual defects have also been corrected by the glasses adapted to relieve eyestrain, this benefit—whether indicated by the opinions of the operatives or by the resulting increase in output—still persists in the case of persons with perfectly normal vision.

In this report thirteen "emmetropes" (persons with normal vision) were tested; two of these gave negative results owing to special circumstances; in three cases the improvement noted was so small as to be inconclusive; but the remaining eight all showed substantial improvement. Five different types of fine work were examined: (i) the examination of steel balls for minute defects, (ii) burling and mending woollen cloth, (iii) linking hosiery, (iv) filing fish-hooks, and (v) chevening by hands (i.e., embroidering designs on hosiery). The average improvement of the emmetropes and ametropes was respectively 26.7 and 28.4 per cent. for ball examiners; 21.9 and 12.3 per cent. for cloth menders; 2.1 and 5.9 per cent. for linkers; and 1.3 and 4.9 per cent. for cheveners.

Workers with normal vision have sometimes shown hesitation in adopting glasses owing to a fear that the artificial accommodation and convergence provided might impair the natural capacity of the eyes and render the continuance of artificial aid indispensable. On this point it is remarked: "This objection appears to be groundless, for, in our experience, workers who have worn the spectacles designed for their special work during factory hours have often found themselves able to do close work, such as sewing, in the evening without the glasses, and without experiencing the discomfort and strain which such work previously entailed when attempted after a day's work in the factory with the unaided eyes. It must be realized that to maintain accommodation and convergence at or near the possible maximum for long periods or for short periods of very frequent occurrence is not itself a natural procedure. No complaints of any undesirable effects attributable to the spectacles supplied to the linkers who formed our original experimental subjects have arisen, although these spectacles have now been used for three years."

* Further Experiments on the Use of Special Spectacles in Very Fine Processes, by H. C. Weston and S. Adams, issued by the Industrial Health Research Board (H.M. Stationery Office, 1s. 3d. Net).



The Illuminating Engineering Society Forthcoming Events

NEXT MONTHLY MEETING.

The next monthly meeting of the Illuminating Engineering Society will take place in the model theatre of the Royal College of Music, on January 21st, 1930, when Mr. Harold T. Ridge will deliver an address on "Stage Lighting," illustrated by lantern slides and demonstrations. Many of our readers will be aware, from perusal of Mr. Ridge's book on the lighting of little theatres, that he has stimulating ideas on the subject, and the forthcoming meeting should be one of exceptional interest. Copies of the introductory paper may be obtained on application to the Hon. Secretary (Mr. J. S. Dow, 32, Victoria Street, London, S. W.1).

VISIT TO THE ZOOLOGICAL GARDENS.

By the kindness of Sir Peter Chalmers Mitchell, C.B.E., members of the Society will be afforded, on January 16th, an opportunity of inspecting certain sections of the Zoological Gardens, such as the reptile house and the aquarium, where the artificial lighting has features of special interest. We believe that it is generally known that in the case of many tropical creatures artificial light is a factor of considerable importance during our cold and dark winter. Interesting illustrations of this experience will doubtless be forthcoming. Members will assemble outside the main entrance to the gardens at 6 p.m. Those who desire to take part in this visit are requested to send in their names to the Hon. Secretary.

SECOND MEETING IN BIRMINGHAM.

Yet another item in the present month will be the second meeting in Birmingham, on January 24th, when Mr. E. A. R. Werner will read a paper dealing with some aspects of industrial lighting. Mr. D. R. Wilson has kindly consented to preside. As in the case of previous meetings in Birmingham, it is hoped that some members from London will be able to travel up and attend the meeting. The Hon. Secretary would be glad to hear from any who are able to do so, and also to receive from them the names of any friends in Birmingham who might be interested.

Lectures on Illumination

The papers read before the Illuminating Engineering Society year by year cover a varied ground, and in the aggregate have a valuable influence. Yet this is only a part of the educational work to be done. There are also opportunities for occasional papers before other societies and organizations, dealing with the aspects of lighting in which they are specially interested. Much more might be done in this way than at present, but we are glad to observe that members of the Society are not infrequently responsible for extra efforts which aid the good work. We have before us copies of the *Transactions* of the Institution of Engineers in Charge and of the *Journal* of the Royal Sanitary Institute. The former contains an address by Mr. W. J. Jones entitled "The Lighting of Public Institutions, with Special Reference to Economics"; the latter a paper by Mr. L. B. W. Jolley and Mr. G. H. Wilson on "Artificial Industrial Illumination," read at the Annual Congress held in Sheffield last July. Both papers deal with fundamental principles of good lighting and strongly emphasize the economic advantages of good illumination.

Articles on Lighting

The remarks at the foot of the last column in regard to lectures on illumination apply equally well to articles on this subject. Here again the journal of the Society does not exhaust available educational channels. Opportunities for articles in other journals often present themselves. A typical and useful effort in this direction is the section on lighting which appears periodically in the *Bulletin of Hygiene*. The October issue of the *Bulletin* contains five pages devoted to abstracts of papers or articles on illumination, all of interest in relation to hygiene. Of the ten articles reviewed five are quoted from *The Illuminating Engineer*, but the rest are drawn from other sources. There is a review of the familiar report of the Illumination Research Committee on "The Effect of Different Systems of Lighting on Output and Accuracy of Fine Work." A particularly interesting item is the analysis of lighting conditions in trains and buses in Berlin, abstracted by Dr. James Kerr. Some of the local railway systems appear to be poorly lighted, notably the Stadtbahn, where the average illumination recorded was apparently only 0.4 lux (under half a foot-candle), and the best result out of 25 tests only 16 lux (a little over 1½ foot-candles). In motor buses also the recorded illumination (6-10 lux) is apparently much below the standard prevailing in London.

Electrical Trades Benevolent Institution

ANNUAL FESTIVAL DINNER.

At the annual dinner of the Electrical Trades' Benevolent Institution, which was held at the Savoy Hotel, London, on November 26th, there was, as usual, an excellent attendance. Mr. H. Marryat, in proposing the health of the Institution, explained that although the electrical trade industry was "the one bright spot in a period of bad trade" there must be many casualties in such a big industry and many calls on the Institution's funds, which, at the beginning of the year, amounted to only £37,000. The customary distribution of blank cheques on the dinner table resulted in the collection of £925, and the additional amounts collected from outside sources raised the total to over £9,000—a record amount. A pleasing item during the dinner was the presentation to Mr. F. B. O. Hawes of a suitably engraved seven-valve wireless set, on the occasion of his retirement from the position of honorary secretary after 19 years' service. The presentation was made by Mr. Justus Eck, acting chairman of the Executive Committee, who paid a graceful tribute to the devoted work done for the Institution by Mr. Hawes during nearly 20 years of service.

Public Lighting and Unemployment

Our contemporary, *Municipal Engineering*, suggests that when the Lord Privy Seal has completed his review of big schemes for the relief of unemployment he might do worse than turn his attention to public lighting—a field where much-needed improvements might provide work for a considerable number of people. A million or two judiciously expended in this direction would be of great public benefit. In doing so he might also consider whether this is not a case for rationalization. At the recent Public Transport Congress attention was drawn to the irregularities which occur owing to divided control, and improvements in this direction are badly needed.

Activities of the German Illuminating Engineering Society

In the course of the proceedings of the German Illuminating Engineering Society held in Vienna during September 12th-15th, now recorded in *Licht und Lampe*, allusion was made to the International Illumination Congress held in the United States last year. This has naturally influenced considerably the work of the various committees of the Society, which appears to cover a wide field. In the field of photometry instructions for the use of the Ulbricht sphere have been issued. The general recommendations on the use of artificial light have been revised. Special attention has been devoted to industrial lighting, and efforts are being made to interest the Government in this subject, so that in future regulations bearing on artificial lighting as well as natural lighting may be adopted. Government departments are also being approached in regard to the use of light for traffic—one problem being whether cycles and motor-cycles shall be compelled to carry rear-lights, a matter that has also aroused much discussion in England. Efforts are being made to define more precisely the qualities of diffusing glassware, frosted and opalescent varieties being divided into three main groups. It is interesting to observe that the initial steps have been taken towards the defining of a standard for the physiological action of ultra-violet light.

The Language of Illuminating Engineering

In *Licht und Lampe* there also appears a lengthy serial contribution from Prof. J. Teichmüller, whose discussions on fundamental questions are always enlightening. It would seem that in Germany the variety of terms used by the lighting industry is even greater than in our country, but there are certain tendencies which one observes everywhere. The need for precision in illuminating engineering was recognized by Lambert in his *Photometria*. We have in use many scientific terms which are of Latin origin. But to these both native expressions and terms imported from abroad have been been added, so that a medley of words, sometimes synonymous, sometimes used with several distinct meanings, is found to exist. To Professor André Blondel is due one of the first attempts to prepare an international code of nomenclature. The terms and definitions approved by the International Illumination Commission, which at least furnish a basis of international understanding, are influenced to a great extent by his work. But behind such efforts there are certain fundamental difficulties—notably the uncertainty whether, in speaking of flux, radiation, etc., we are concerned with the radiant energy or with the physiological impression which it produces on the eye. There is the further fundamental question whether flux of light or candle-power should be the primary unit, and the complexities arising from measuring systems—the C.G.S. system not being yet universal. Apart from this, such terms as candle-power and intensity; illumination and intensity of illumination; lamp, source of light and lighting unit are used more or less indiscriminately, and we have always with us the unpleasing term "fitting," for which the United States has valiantly attempted to substitute "luminaire." In connection with lighting apparatus we have a miscellany of terms such as globes, bowls and reflectors, armatures, shades, screens, dishes, etc., though we escape such anomalies as the German "blende," which, strangely enough, is a screen which avoids "blendung" or glare. (Readers of the paper by Mr. Stiles, which appeared in our last issue, need not be reminded that glare itself is used to denote many different phenomena!) Prof. Teichmüller makes a conscientious effort to explore the language of lighting and arrange the terms in a more orderly manner, and his contribution, though naturally dealing primarily with terms used in Germany, deserves study at the hands of English readers.

Illumination or Wiring Standards

In a recent article in *The Electrical World* Mr. J. R. Cravath discusses the question how far it is desirable to standardize lighting specifications or replace them by what are really "rule-of-thumb" methods. In the Franklin specification, which has been widely adopted in the United States, a definite plan in regard to illumination is adopted, and approximate data on outlets and wiring have been derived. The California "red seal" plan is based on similar methods, assuming an allocation of 3 watts per square foot (according to British experience a generous allowance), with modifications in certain cases. It is urged that the wide adoption of such methods tends to check originality in design, that illuminating engineering is not really so simple as such rules suggest, and that the effect is rather to discourage those who aim at practising illuminating engineering as an art. There is much to be said for these objections. On the other hand, the simplicity of such methods has proved acceptable to architects and builders, and has probably resulted in a general levelling-up of the standard of illumination. Extreme standardization can only be properly applied to buildings destined for a common purpose, more especially those of the commercial class. Even in this field the illuminating engineer knows quite well that cases often arise where rule-of-thumb does not apply. In those instances where decorative appearance is important standardization becomes futile. The development of "architectural lighting" seems likely to counteract any tendency towards undue standardization, for it is here admittedly impossible to follow conventional methods. "The effect" is the important consideration, and there is ample field for ingenuity on the part of the designer.

Obituary

Guido Semenza.

We record with regret the death of Sig. Guido Semenza, which occurred on November 7th. Signor Semenza was for many years prominently associated with developments in electrical engineering in Italy, and did much to encourage the study of the international aspects of engineering. He was honorary President of the International Electrotechnical Commission on Illumination, and a past President of the Italian Institution of Electrical Engineers. He was also a corresponding member of the Illuminating Engineering Society, in which he took a great interest. Signor Semenza was born in London, and spent some years with the Edison Co. in America, afterwards becoming associated with the Milan Edison Co. He was the author of many original contributions on electrical subjects, and served on many committees, and was one of the most widely known of eminent Italian electrical engineers.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Problems in Illuminating Engineering

(Proceedings at the Meeting of the Illuminating Engineering Society held in the Lecture Theatre of the Home Office Industrial Museum, at 6-30 p.m., on Tuesday, December 10th, 1929.)

A MEETING of the Illuminating Engineering Society was held in the Lecture Theatre of the Home Office Industrial Museum, Horseferry Road, Westminster, on Tuesday, December 10th, 1929. Members assembled for light refreshments at 6-30 p.m., and Dr. J. W. T. Walsh (President) took the chair at the subsequent meeting, which commenced at 7 p.m.

After the minutes of the last meeting had been taken as read the Hon. Secretary announced the names of the following applicants for membership:—

Fabian, H.....Technical Assistant, L.L.C. Power Station, 9, Albert Road, Peckham, London, S.E.15.

Glitheroe, A. R.....Editor of *Electrics*, 153, Revelstoke Road, Wimbledon Park, London, S.W.18.

Walker, R.....Architect, New Oxford House, Hart Street, London, W.C.

The names of applicants presented at the last meeting* were read again, and these gentlemen were formally declared members of the Society.

The PRESIDENT then explained that they had a considerable number of interesting contributions on "Problems in Illuminating Engineering." The first item on the programme was a description, by Prof. Harold Robertson and Mr. B. Ionides, of the lighting of the new Savoy Theatre and Hotel. As both these gentlemen had to leave early he would expend no more time, but would call on Professor Robertson to present his contribution.

Professor H. ROBERTSON then gave an account of the external lighting of the Savoy Theatre and Hotel, features of which were the use of novel forms of illuminated signs and an illuminated canopy of the type recently illustrated in the paper before the Society on "Architectural Lighting." Mr. B. Ionides then gave a description of the interior lighting of the Savoy Theatre, which consisted mainly of artistic concealed lighting, and of which several very pleasing illustrations were shown.

The next item was a description by Mr. F. C. SMITH of the large illuminated gas-lighted sign outside Watson House. The sign is not only interesting as an example of concealed lighting with gas but is a striking object seen from across the river. Attention was drawn to the special problems in connection with maintenance arising from the unusual position of the sign and the ingenious arrangements whereby lamps can be withdrawn for attention.

Mr. A. CUNNINGTON then dealt with "The Illumination of Large Vertical Surfaces," showing, by the aid of illustrations, the difficulty in securing even illumination of advertisement placards, illuminated name-plates of railway stations, time-tables, etc., and describing various methods of getting good results. Attention was drawn to the great advantage of illumination by transmitted light, when this was feasible.

Mr. E. STROUD then described a novel composite unit for the Lighting of Operating Tables in Hospitals, based on the use of a large number of prismatic-glass plates, under separate control. By this means a high intensity of illumination free from troublesome shadow effects could be obtained. The effect was illustrated by an actual photograph of an operating theatre with this system in use.

Mr. S. G. ELLIOT described the lighting of the new "Underground" building at St. James's Park, which had several novel features. The diffused lighting of the corridors leading to the booking hall, the concealed lighting of counters at offices, and the floodlighting of the tower of the building were illustrated.

In conclusion, Mr. H. L. STALLAN dealt with the problem of Motor-Bus Lighting. He drew attention to the special difficulties arising from the fact that all power had to be supplied from the engine, the restricted head-room, etc. Various arrangements of lamps hitherto in use were illustrated, and a complete lighting outfit for a typical bus was exhibited. In conclusion, Mr. Stallan described the very latest method of lighting the most recent model of bus, by the aid of lamps concealed behind a curved panel of diffusing non-inflammable celluloid.

After a brief discussion the PRESIDENT moved a very cordial vote of thanks to the authors, who had provided a most interesting evening. He added that special thanks were due to the London General Omnibus Co. Ltd., who had kindly made arrangements for one of the latest models of buses, utilizing the system of lighting described by Mr. Stallan, to be on view outside the building.

This vote of thanks having been carried with acclamation, the PRESIDENT announced that:—

(1) On January 16th, 1930, a visit to the Zoological Gardens for the purpose of inspecting the special lighting of the Reptile House and the Aquarium had been arranged. Members would assemble outside the main entrance to the Gardens at 6 p.m. Those who desired to take part in the visit were asked to send in their names to the Hon. Secretary.

(2) On January 21st, 1930, a meeting would be held in the theatre of the Royal College of Music, South Kensington, when a paper on "Stage Lighting" would be read by Mr. Harold T. Ridge.

(3) On January 24th, 1930, a special meeting would be held in the Assembly Hall of the Chamber of Commerce, Birmingham, when a paper dealing with industrial lighting would be read by Mr. E. A. R. Werner. The Hon. Secretary would be glad to hear from any London members who were able to attend.

* *The Illuminating Engineer*, December, 1929, p. 303.

Problems in Illuminating Engineering

(Presented at the Meeting of the Illuminating Engineering Society, held in the Lecture Theatre of the Home Office Industrial Museum, Horseferry Road, London, S.W.1, at 6-30 p.m., on Tuesday, December 10th, 1929.)

As indicated in the general account of this meeting on the preceding page, the "problems" illustrated and discussed were of a very varied character.

THE EXTERNAL LIGHTING OF THE SAVOY THEATRE.

The first item on the programme was an illustrated account, by Professor H. ROBERTSON, F.R.I.B.A., of the external lighting of the Savoy Theatre and Hotel, which presents novel features.

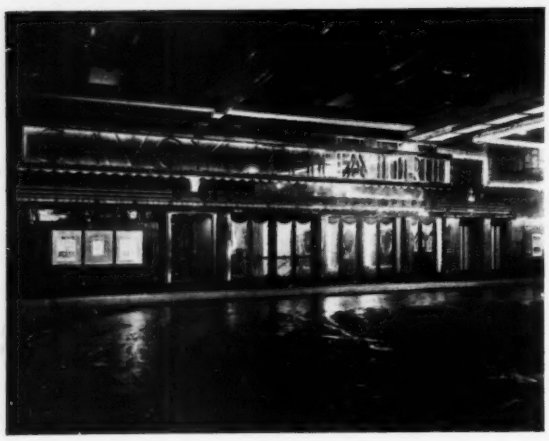


FIG. 1.—A View of the Courtyard of the Savoy Theatre.

In introducing his subject Professor Robertson remarked that the technical resources of electrical engineering consultants and contractors do not appear to have been fully utilized in England up to the present time. With the exception of a few isolated signs and shelters, enterprise in external lighting seemed to have stopped short at floodlighting and the use of neon, which, however, is used for the most part without taking full advantage of its charming possibilities. In the lighting of the new approaches to the Savoy and the theatre fronts, the designers have attempted to utilize lighting as a more definitely architectural and decorative element.

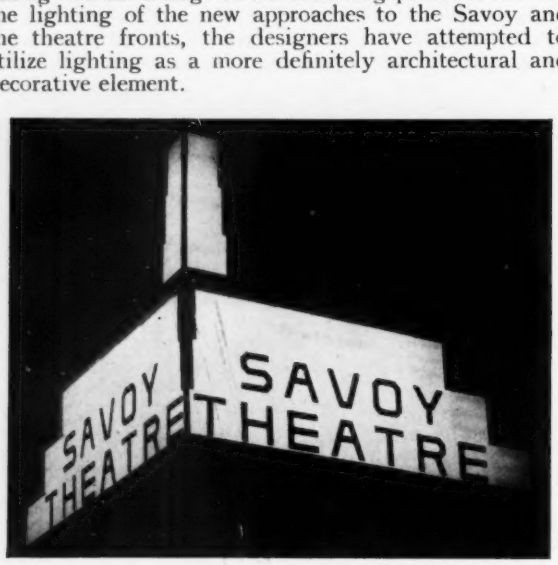


FIG. 3.—A closer view of one of the Signs.

Proceeding, Prof. Robertson suggested that, for the lighting of an entrance to an hotel of the class of the Savoy, lighting too theatrical or too much on *réclame* lines would be unsuitable. What is here required is practical illumination, cheerfulness, a note arresting but not indiscreet, a sense of invitation.

For the lighting of a theatre front, a higher key may be employed. But at the Savoy the problem is complicated by the proximity of hotel and theatre and the fact that the façade of the latter forms part of an ensemble, and is also the main feature visible from the hotel grill room. Advertisement, therefore, had to be discreet, the effect amusing but not bizarre, and light must not interfere with the daytime architectural effect.

Here at once appears a difficulty. Too many lighting schemes, both here and abroad, are unsightly in daylight, and this is particularly true of designs in which

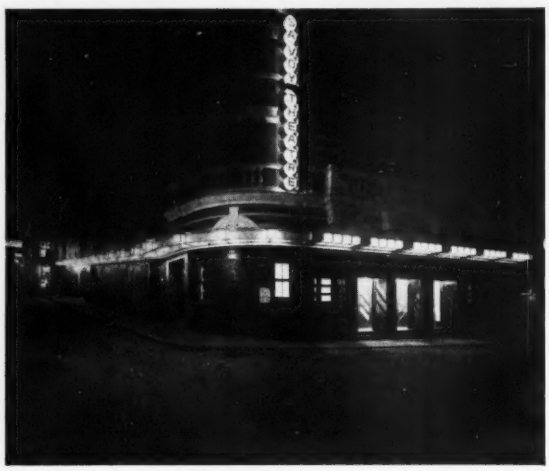


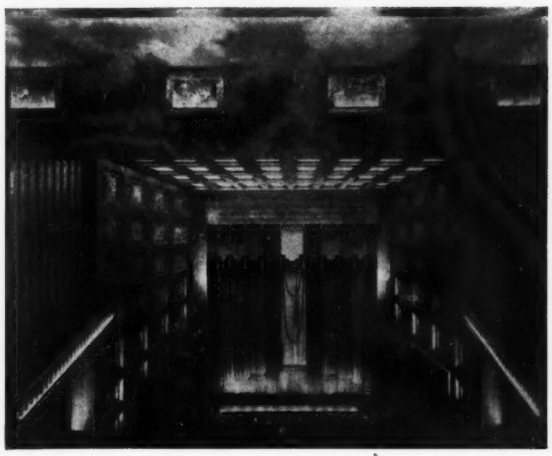
FIG. 2.—Showing the striking Luminous Signs outside the Savoy Theatre.

the naked bulb is exposed, or in which neon-tube effects are coarsely contrived. The French, in this latter field, have been very successful, and have "spotted" the mechanism of the tubing in such a way as to contribute to the general design.

The Savoy Courtyard scheme is based upon the covered approaches. The basic idea is to lead people towards the hotel and theatre and achieve some sort of a climax in the courtyard; to this end the lighting effects were carefully considered. It must be realized, however, that suggestions for treating the actual hotel front are not yet realized, and the ensemble is therefore incomplete.

FIG. 4.—Another Sign of novel design.

The lighting of the shelters is by a series of closely spaced bulbs on the outer edge of the soffit. These are concealed in a "V"-shaped trough of flashed opal glass. It was desired that the line of light should be continuous, and that no metalwork should show. This has been realized, but certain economic reasons have prevented the effect from being devoid of spottiness,



FIGS. 5 and 6.—Two charming views showing the Interior Lighting of the Savoy Theatre.

which the architects would have wished to obviate as far as possible.

The troughs continue up the risers of the shelter adjoining the arch, and across the soffit of the latter. In addition, the soffit across the roadway is lit by large lighting boxes contrived in the thickness between the arch beams. There is also, on the face, a trough which lights upwards into the steel face of the arch.

On this face are large letters of wood, gilded. These are projected several inches from the steel face, leaving room behind the letters for tubes of green neon. The lighting is thus less obvious, and the letters retain their clean appearance in the daytime.

The courtyard itself has been fitted with new rectangular hanging light boxes, these being suggested as requiring less current and upkeep than trays or fittings of a complex design.

The theatre front has as its main feature a sign, "Savoy Theatre," which runs across the entire front, including a row of windows which are required for offices. These presented difficulty in the design, but the decision to include them in one broad scheme seems to have been justified.

The sign consists of large projecting wood letters, showing a thin profile. They are set away from the steel façade about 3 ins., so as to permit light from the troughs, which form the frame to the sign, to pass behind them and reflect in the background of the sign, which is of a special design of mirror glass, the pattern of which is being repeated in the aforementioned windows of the offices.

The glass to these troughs is pink. Below the sign is another and interchangeable sign, the letters of which are lit from below by lights concealed in the projecting trough on which they stand. In this case the glass used is yellow.

At either side of the façade are wide display cases, lit on a novel principle,* the glass of the fronts being curved.

The embankment façade also has a shelter, lit from within the space between the glass roof and soffit. The intention, which has been successfully realized, was to produce an effect of solid light, with a minimum of metalwork obstruction. The elimination of metal frames required careful thought in the construction of the light boxes.

On the side shelter, in Carting Lane, a combination of square luminous fittings and light boxes at intervals on the vallance has been used with good effect.

The theatre signs, five in number, are an interesting feature of the scheme. Two of them employ luminous cubes, and one is a flash sign with changing colours. On the theatre façade is a sign of glass discs, also with an intermittent flash and play of colour. These signs are, in their way, novelties for London.

* This novel method of illuminating signs and pictures was exhibited by Mr. A. W. Beuttell at the opening meeting of the Society on October 8th, 1929 (*The Illuminating Engineer*, November, 1929, p. 290.)

In conclusion, the author remarked that the success of certain Continental effects of truly architectural lighting, notably German examples, was an inspiration to the architects. Time and opportunity for study and experiment were, however, completely lacking in this case, and the work was carried out at very short notice. On behalf of the architects he wished to acknowledge very effective collaboration of the engineers and of the firms concerned in the execution of the work, which, as is the case with all theatre buildings, required speed equally with skill and understanding.

SAVOY THEATRE INTERIOR LIGHTING.

Mr. BASIL IONIDES, who dealt with the interior lighting at the Savoy Theatre, said that the main object was to obtain an effect of sunlight without any glare, so that the audience might have that feeling of comfort that the sun imparts.

FIG. 7.—A novel type of Decorative Lighting Fittings.

To get this effect the light had to come from above, but without casting any sharp shadows. After various experiments it was found that this could be done by reflecting at various angles, so that the light hit the gilded surfaces of the walls and shone off them on to the audience. The lights above the upper balcony were, however, kept "cool" in tone, as this part is apt to be hot in itself. In that part there was a blue ceiling on which the light was cast.

The front part of the ceiling had coffers, which were

open, and above these were lamps, concealed on the audience side of each square. Their light was thrown on to reflectors above each square, and again reflected down and on to the side walls. The reflectors were originally white stoved, but this produced a certain impression of glare and they were accordingly treated with paint which made the light colour perfect for the purpose. This light, in the fore part of the house, was aided by a strip of light round the front of the balconies, concealed in a plaster trough. The balcony front above it is of gold, so that the reflected light is sunny.

All this was comparatively easy, but the lighting of the undersides of the balconies was difficult, as there was very little height to play with, and sunk silvered panels were adopted. At the far ends there are lamps shaded with golden glass which glitters down the panels. As some of these panels are curved in surface they pick up the light well.

At the back of the dress circle ceiling another trough casting light on to a cove was utilized, and at the back of the stalls reflectors to cast light on to the fluted walls.

The walls, being all of a gold and shiny surface, "pick up" light from everywhere, and there are no dark corners. No electric fittings are used as ornaments in the front of the house, but in the corridors and bars some simple types have been adopted.

The Lighting of Large Vertical Surfaces.

Mr. A. Cunnington said that although the subject he was dealing with had been put down as the lighting of large vertical surfaces because he had in mind posters, large station nameboards, etc., the real problem in view was how to spread a flux of light over a surface with the illuminant close to the surface. The latter point was the distinguishing feature as compared with room and street lighting and other forms of horizontal illumination.

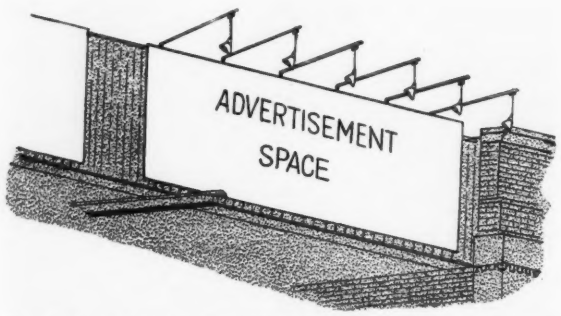


Fig. 9.—Another installation with Lighting Units so placed that they do not fall between the eye and the sign, and permitting easy access from behind.

Mr. Cunnington then reviewed the available methods of dealing with the problem both by external and internal illumination. He referred to the device recently shown before the Society by Mr. Beuttell as being the only method that gave anything like complete uniformity of illumination with a source of light quite close to, and in front of, the surface to be illuminated. He also emphasized the importance of bearing in mind the need for easy access to the illuminant for maintenance purposes and showed some diagrams of methods adopted on the Southern Railway where special attention had to be given to this feature.

Reference was made to the unsightly installations which were sometimes to be seen, the chief fault being that reflectors in front of posters were placed too low and often allowed to be much too conspicuous. He showed a particularly good example of the way in which this could be avoided by careful design. After showing other examples of external lighting, Mr. Cunnington emphasized the advantages of using illumination from behind through a translucent medium wherever this could be adopted. He contrasted a map illuminated by external reflectors with one internally lighted, showing that with approximately the same watts per square foot the average brightness was a 100 per cent. greater in the second case and at the same time the diversity ratio was halved. Apart from the efficiency of internal illumination (which is not unimportant), there is an advantage in the case of maps and time-tables in that the observer does not cast his own shadow over the illuminated surface.

In dealing with large name-plates, hoardings, etc., Mr. Cunnington pointed out that more or less glossy surfaces were not infrequently used, and in such cases troublesome direct reflections of the light sources were apt to give trouble.

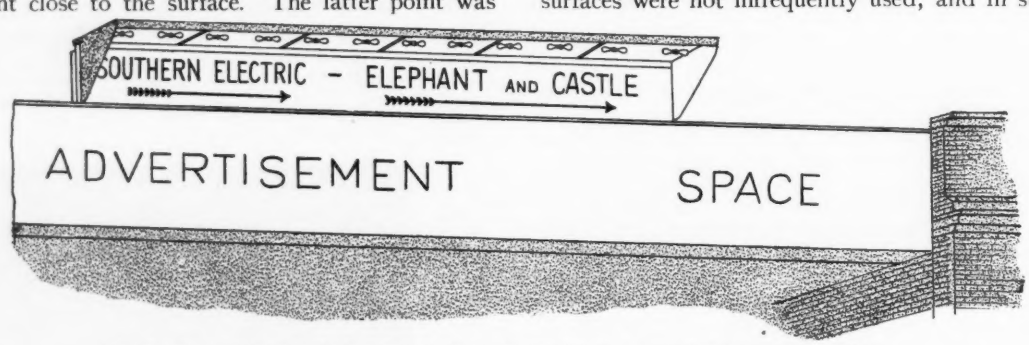
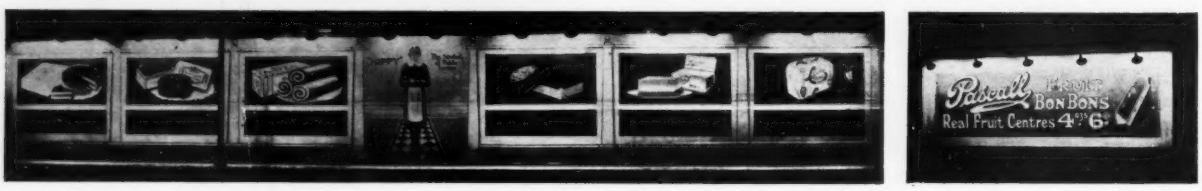


Fig. 8.—A convenient method of illuminating a large sign in a somewhat inaccessible position.

In this connection reference was made to the system of lighting time-tables, on translucent paper between glass plates mounted on inclined racks and illuminated from within, which was first adopted at Waterloo station and was illustrated in the journal many years ago.

Some reference was made to the lighting of station name-plates and entrances to railway stations. In the latter case strictly uniform illumination was not always necessary, as was illustrated by the night view of an entrance to a tube station (Fig. 12). The gradual shading-off of the brightness as the eye travelled upwards was a natural effect. Attention was drawn to the emphasis of the horizontal dark lines, an effect which had been strongly approved by an architect to whom this view was shown.



Figs. 10 and 11.—Two examples of Concealed Lighting of Hoardings, by means of overhead lighting units.

In conclusion Mr. Cunnington referred to possible future developments and thought that some application of the vacuum tube principle, such as in the neon tube

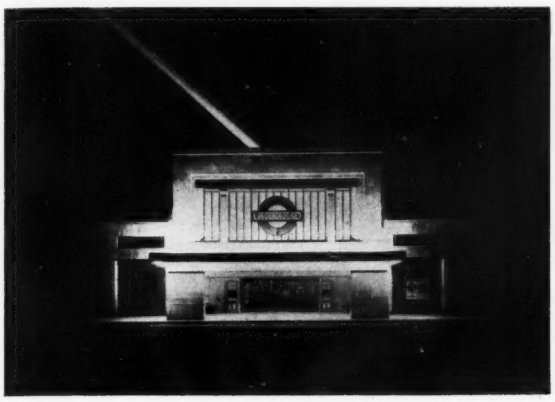


FIG. 12.—Lighting the Entrance to a Tube Station. Attention may be drawn to the architectural effect of the black lines and to the increase in illumination as the eye travels from the high line to the pavement.

or the earlier Moore tubes, might enable them to get an even distribution of light flux without concentration of the light sources in a number of separate units.

THE LIGHTING OF HOSPITAL OPERATING TABLES.

Mr. E. STROUD said that the problem of lighting hospital operating tables involved the provision of a very high intensity of concentrated illumination, which must be practically shadowless, but must give a high vertical component of intensity, ensuring penetration into deep cavities. This superintensity should be confined to the wound area, but at the same time moderate illumination must be furnished throughout the room. This general illumination should be such as not to compare with that on the operating table; but it should be sufficient to prevent the eyes of the surgeon and his attendants being fatigued by excessive contrast as the gaze was directed in turn on the table and on surroundings.

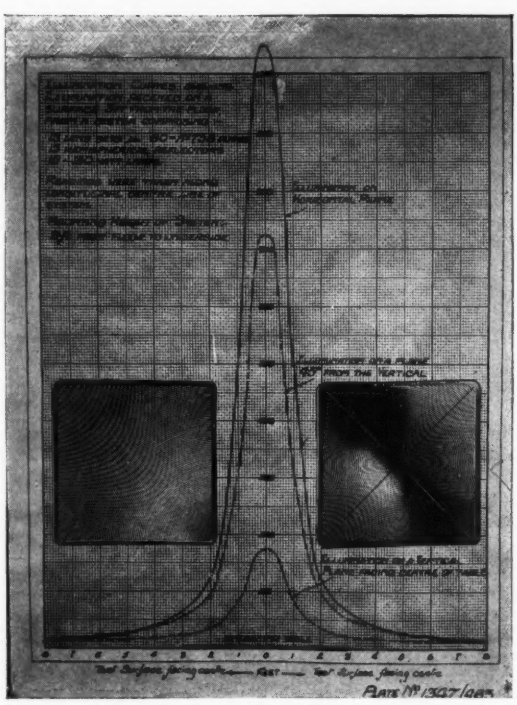


FIG. 13.—Showing conditions of Illumination obtained from a 15-lens Operating Table Outfit.

The high intensity should be produced without striations or glare, and the light unit should be as unobtrusive as possible.

To fulfil these specific conditions a special unit had been developed, consisting of a number of prismatic plates formed into a panel or false ceiling of relatively large area. The prism construction of the plates was such as to refract the light rays which reach them into a converging beam of high intensity. Each plate was 12 inches square and was formed with quarter-concentric prisms. These were used in groups of four, each group forming one large lens 24¼ inches square, having a 12¼-inch focus.

The complete unit consisted of either 15 groups of four plates each approximately 10 ft. by 6 ft., 18 groups, 12 ft. by 6 ft., or 21 groups, 14 ft. by 6 ft. Over each group of four plates was fitted a lamp and reflector, in such relation to each other that the maximum beam fell at the centre of the operating area; thus with a 15-group system the combined 15 concentrating beams, coming from different directions, built up and focussed their rays over the predetermined area.

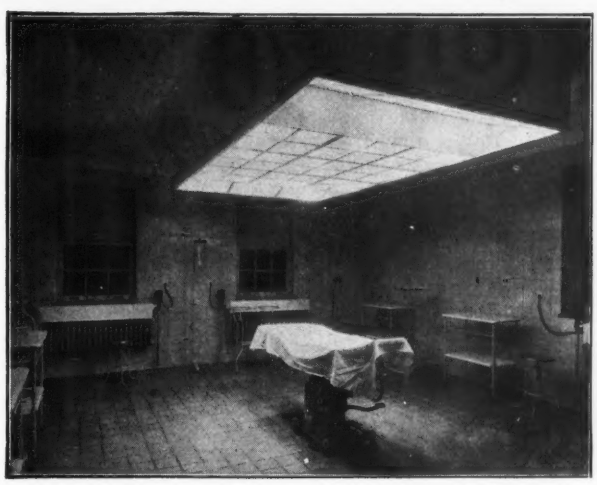


FIG. 14.—A general view of an Operating Room lighted solely by the special unit described.

The method employed differed from a reflector system insomuch that concentration from the large refracting area secured adequate diffusion, avoided harmful shadows and absolutely prevented glare. The "overflow" from the lens system gave sufficient general illumination to avoid undue contrast, and the optical characteristics of the lens were such that a three-dimensional soft or dissolving spot was developed to allow for varying thicknesses of bodies and heights of tables.

The illumination obtained with a 15-lens system employing fifteen 150-watt lamps, i.e., 2,250 watts, was shown on the curves (Fig. 13), the maximum horizontal illumination being 1,050 foot-candles, the illumination on a plane 45° from the vertical 725 foot-candles, and the illumination on a vertical plane facing the centre of the table 175 foot-candles. These high intensities were obtained without any semblance of glare.

The smooth side of the plates faced towards the light source, and the complete unit being totally enclosed and forming as it did the ceiling of the operating theatre prevented any danger of collection of dust particles, no obstruction projecting into the theatre.

In conclusion, Mr. Stroud mentioned that a model of this novel operating-table outfit was on view a short distance from the lecture hall, and was available for subsequent inspection by any members of the audience interested.

THE LIGHTING OF MOTOR OMNIBUSES.

Mr. H. L. STALLAN, before dealing with the actual illumination of the motor buses, mentioned some of the difficulties in first obtaining the necessary current on a petrol-driven vehicle.

The first problem was to obtain the current on a petrol-driven vehicle the engine of which was running at a variable speed. The early dynamos were originally of the constant-current type, which had numerous drawbacks. During the past three years considerable progress had been made with the constant-potential dynamo, which was now being fitted extensively. These had several advantages over the constant-current type:

(1) The battery is kept fully charged, and as the battery voltage increases the charging current decreases, the dynamo and the battery being thus prevented from overcharging; (2) the machines are of the ordinary shunt-wound type, the power required to drive them being proportional to the output.

Driving the dynamo was another difficulty, as the engines were not originally designed for this purpose.

During the last two years designers have more carefully considered the dynamo drive, and the increasing use of six-cylinder engines simplifies the arrangement for positively driving the dynamo, which is directly driven on the magneto shaft running at 1½ times engine speed. With the constant-potential machine, in addition to the auto cut-out (which disconnects the dynamo from the battery at low speeds), a field regulator is provided. This automatically inserts resistance in the shunt field of the dynamo by means of a vibrating variable resistance.

Accumulators proved one of the most expensive and most unreliable parts of the early equipment. To-day accumulator plates much better able to stand the heavy vibration and the variable charging rates obtained on a road vehicle are available.

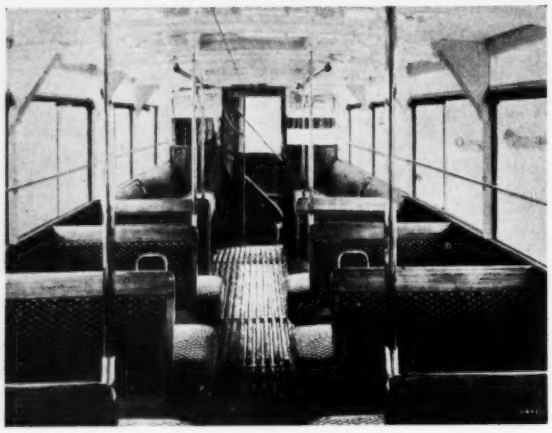


FIG. 15.—Showing the Lighting of Motor-bus Interior with opal-bulb lamps.

Having obtained a supply of current by utilizing the previously mentioned equipment, there still remain difficulties in the actual illumination of the body interior. The head room in a bus is generally much less than an electric train or tramcar. Originally miniature fittings were used, but now the ordinary bayonet-cap fittings are adopted. This has been made possible by the design of a special lamp holder taking up considerably less height than the standard batten type. Further, the large fittings allow cables to be looped in, obviating joints.

Owing to lack of head room, it was originally necessary to fix our lamp fittings close to the ventilators which run along the side of the bus, the police regulation only allowing 5½ inches inside the body. The disadvantage of this was that a great deal of light was thrown into the road. Further, the early bulbs had to be enclosed in an outer well or dish glass. About three years ago, at the introduction of the pipless lamp, sanction was obtained to abolish the outer glass. This was a distinct improvement, and also a saving in weight.

The actual illumination of the bus when the dynamo system was first adopted was not very high. The interior was fitted with six 10-watt metal-filament lamps, the total number of lamps on the vehicle, which included regulation lights, being twelve. To-day there are twenty-four 12-watt lamps inside the larger buses—a total of 47 lamps as the complete equipment of the vehicle. The increase in watts is thus over 350 per cent., and in the seating capacity 100 per cent.

Originally it was only possible to obtain lamps with either clear or externally frosted bulbs. Owing to the difficulty of keeping the latter clean, clear bulbs were generally used, leading to a considerable amount of glare. During the past three years the clear-bulb vacuum-type lamps have been gradually eliminated in favour of the opal gasfilled lamp. Originally the lamp life was very short, owing to the fluctuating voltage, but the advent of the constant potential system has led to a great improvement in this direction.

Experiments have shown that distribution of light from the opal bulb is much better than that from the internally frosted lamp in connection with motor-bus lighting. The appearance is also better, and the loss of light apparently not of great moment.

Recently improved types of omnibuses have been designed. Internally they are fitted with domed roofs extending approximately 8 inches below the cant rail, for improving the appearance. The chief engineer suggested abolishing the ordinary electric fittings and endeavouring to utilize a section of the dome with a translucent material illuminated from behind so that no obstruction should be shown on the lines of the vehicle, at the same time obtaining a diffused lighting effect.

Glass could not be used for this purpose. Accordingly a non-inflammable celluloid, which was sprayed white for experimental purposes, was obtained and tried, with favourable results. More recently a non-inflammable

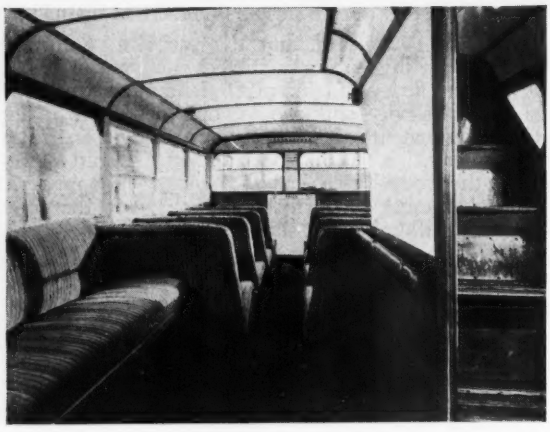


FIG. 16.—Showing Latest Method of Lighting Motor Buses by lamps concealed behind curved panel of diffusing celluloid.

celluloid which has the pigment mixed in it during manufacture has been obtained. This has increased the illumination by 100 per cent. The new vehicles will shortly be fitted with this material. In the meantime experiments are being made with several other types of material, though so far without improvement on the variety referred to above. The illumination at the average reading height of the new buses when fitted with this material is about 6 foot-candles, and, when further experiments are completed, this should form a pleasing concealed lighting system for omnibuses.

It may be of interest to lighting engineers that sanction has recently been obtained for illuminated destination blinds to be used instead of the old externally illuminated bowls. It was found that owing to the small amount of room available clear bulbs did not illuminate the blind properly. This defect has now been overcome by fitting opal bulbs which give a very evenly distributed light, and the wording is very distinct.

With the growing demand for more light and electric power on omnibuses the size of the generator will become too large to be reasonably driven by the existing engine. There is no doubt that an independent lighting plant will ultimately have to be installed.

Experiments with a plant of this description, driven by a single-cylinder engine, have already been made. Except for the vibration, it was quite successful; possibly by utilizing a two-cylinder engine an efficient plant for lighting big vehicles may shortly be evolved. An arrangement of this description would have many advantages over the present variable-speed system driven from the main engine.

In conclusion, Mr. Stallan exhibited a complete lighting equipment as fitted to the latest types of omnibuses.

FIG. 17.—Watson House seen at night from the Embankment, showing the appearance of the sign illuminated by gas.

THE LARGE GAS LIGHT SIGN AT WATSON HOUSE, NINE ELMS.

Mr. F. C. SMITH then contributed an interesting illustrated description of the large illuminated sign outside Watson House, the training centre of the Gas Light and Coke Co. at Nine Elms.

Fig. 17 is a view of the sign showing its appearance as seen from the Embankment opposite Watson House. The sign is approximately 60 ft. above the river level and extends across the whole face of the top of the premises, with the river actually washing the base of the building. The position of the sign demands that special facilities shall be available in order that the lamps may be maintained with ease and safety.

Fig. 18 gives some interesting data in respect of the sign. It will be observed that the total length is 110 ft. The letters are made up of chippings of white glazed stoneware set into light blue background of the same material. Each letter is outlined with black. The lighting of the sign is effected by 27 units; 10 of these are 9-light superheated lamps fitted with medium mantles, and these serve to illuminate the centre portion of the sign. The lamps are fitted 4 ft. from the facia. The remaining 17 units are 7-light superheated lamps fitted with medium mantles. These are fixed 3 ft. from the facia and illuminate the portions of the sign on either side of the centre previously referred to.

Fig. 19 is a polar curve of light distribution for the 9-light lamps. The distribution from the 7-light lamps has very similar characteristics.

Fig. 20 is a curve giving the illumination over the centre portion of the sign. It will be observed that the maximum illumination is 8.5 foot-candles, the minimum being 4 foot-candles. The somewhat

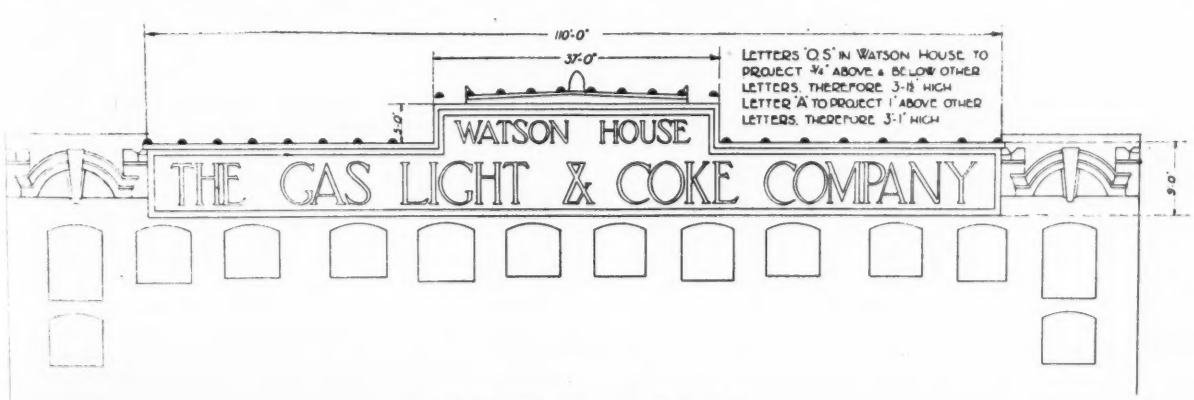

110'-0"
37'-0"
LETTERS 'O.S' IN WATSON HOUSE TO PROJECT 3/4" ABOVE & BELOW OTHER LETTERS. THEREFORE 3'-1" HIGH
LETTER 'A' TO PROJECT 1" ABOVE OTHER LETTERS. THEREFORE 3'-1" HIGH
WATSON HOUSE
THE GAS LIGHT & COKE COMPANY
9'-0"

FIG 18.—Showing dimensions of the sign.

singular indentation shown on the curve on Fig. 20 at approximately 4 ft. below the lamp level is due to the fact that the lamps are fitted with globes, one section of which is frosted in order to prevent glare on the top portion of the sign.

Fig. 21 is of interest as showing the ease with which these lamps may be drawn up the ramp and brought inwards to enable the units to be easily maintained.

Fig. 22 is a "close-up view" of this arrangement. The gas connections are such that the sign is divided up into six sections for the purpose of control and lighting; three sections comprising five lamps in each section and three sections of four lamps. Each lamp, however, is also under separate control. The lighting and extinguishing of the lamps is effected by means of the well-known Sugg distant control. The sign is in an exceedingly exposed position. It was, therefore, necessary to use windproof lamps if the maintenance costs were to be reduced to a minimum. Running costs show the charges incurred for maintenance to be very low.

The whole installation is interesting as an example of concealed lighting by gas, especially in view of the special problems arising from the position of the lights and the features of design necessary to facilitate regular upkeep and maintenance.

The final item was a description by Mr. S. G. Elliot of the lighting of the new building of Underground Railways Ltd., at St. James's Park Tube station, which presents many novel features. The following summary of Mr. Elliot's contribution deals mainly with the lighting of the interior, but some reference is made to the floodlighting of the tower, a prominent object as seen from St. James's Park. Mr. Elliot also showed some views of a new pedestal indirect-lighting unit of pleasing design which is now in use at the Piccadilly Tube junction station. (Readers will recall that this installation was described by Mr. Elliot at a meeting of the Society held early in 1929.)

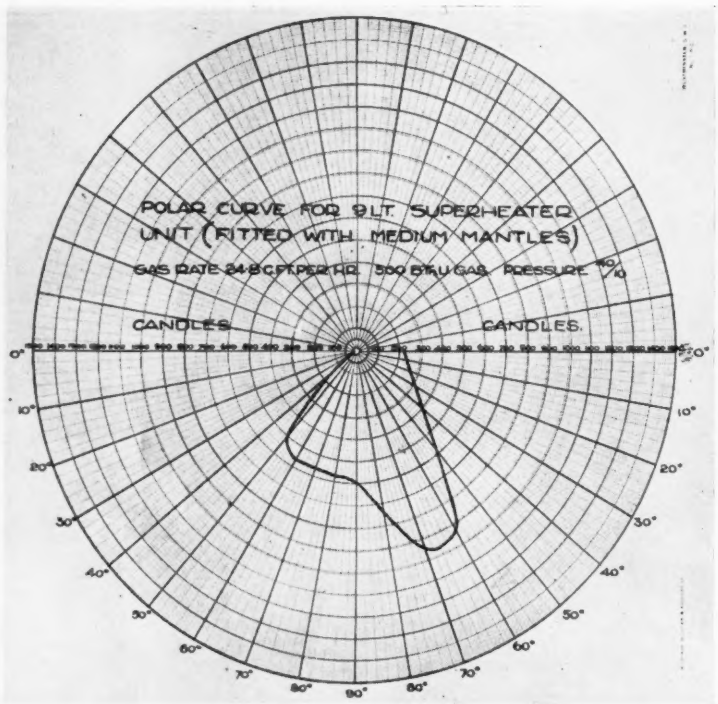

POLAR CURVE FOR 9 LT. SUPERHEATER UNIT (FITTED WITH MEDIUM MANTLES)
GAS RATE 24.8 C.FT. PER HR. 500 B.T.U. GAS. PRESSURE 2" W.G.
CANDLES.
CANDLES.

FIG. 19.—Showing polar curve of light distribution for the 9-light lamps.

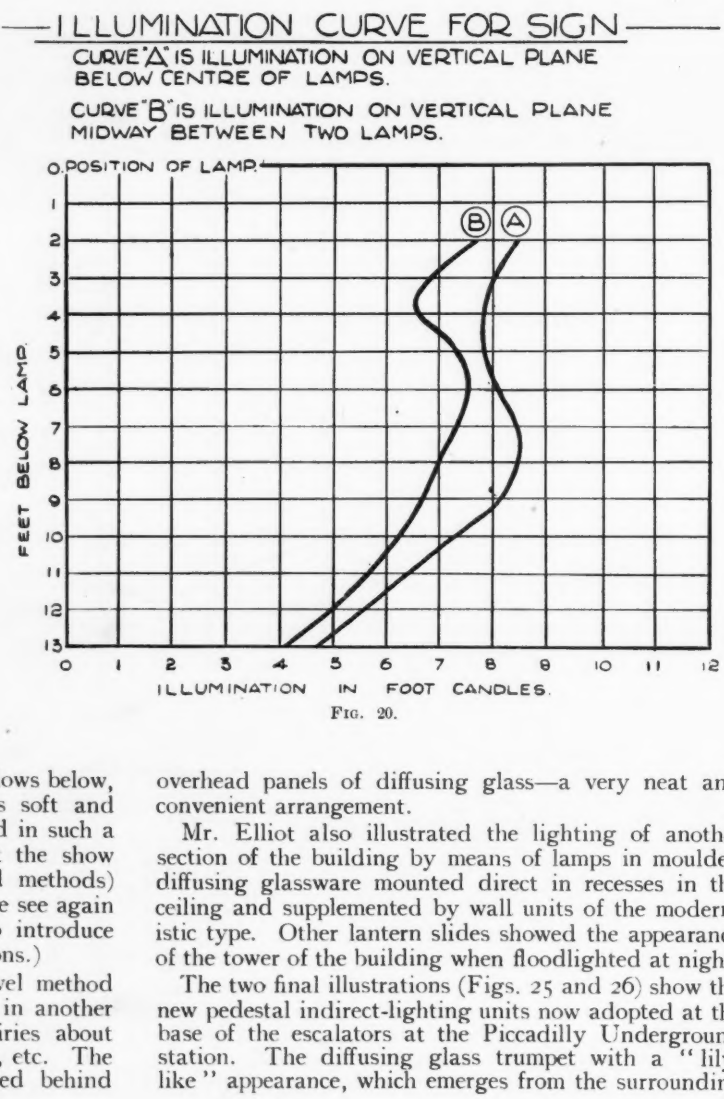

ILLUMINATION CURVE FOR SIGN
CURVE "A" IS ILLUMINATION ON VERTICAL PLANE BELOW CENTRE OF LAMPS.
CURVE "B" IS ILLUMINATION ON VERTICAL PLANE MIDWAY BETWEEN TWO LAMPS.
POSITION OF LAMP
FEET BELOW LAMP.
ILLUMINATION IN FOOT CANDLES.
B
A

FIG. 20.

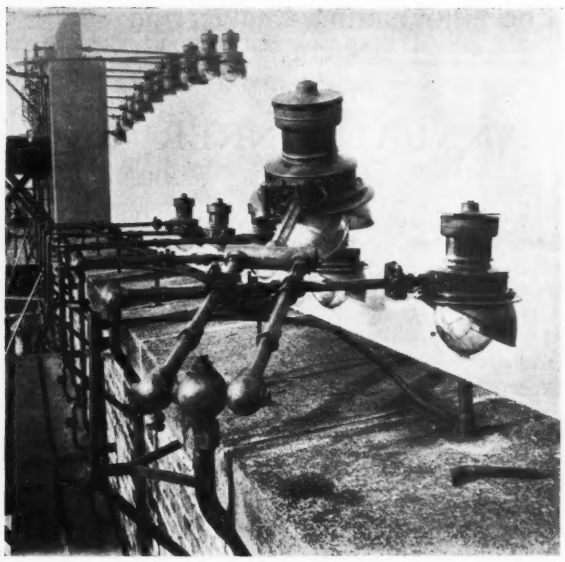
THE LIGHTING OF THE NEW "UNDERGROUND" BUILDING.

The interior lighting, as well as the planning of this new building adjacent to St. James's Park Tube station, is on original lines, a feature being the use of concealed and indirect methods. Mr. Elliot explained that a number of passages, traversing the part of the building devoted to offices, converge on the concours of the sitation where tickets are purchased. One of these passages is illustrated in Fig. 23. It will be observed that the general lighting is of a diffused character, being furnished by lamps in troughs at the side of the passages, and above the miniature shop windows below, at present in process of completion. This soft and moderate illumination is just what is needed in such a passage, and is not too strong to prevent the show windows (also to be lighted by concealed methods) being the most prominent element. (Here we see again an illustration of the growing tendency to introduce shop windows in the vicinity of railway stations.)

Fig. 24 is interesting in showing the novel method adopted for lighting the counters of offices in another passage, where passengers can make enquiries about season tickets, articles lost in trains, services, etc. The counters are illuminated by lamps concealed behind overhead panels of diffusing glass—a very neat and convenient arrangement.

Mr. Elliot also illustrated the lighting of another section of the building by means of lamps in moulded diffusing glassware mounted direct in recesses in the ceiling and supplemented by wall units of the modernistic type. Other lantern slides showed the appearance of the tower of the building when floodlighted at night.

The two final illustrations (Figs. 25 and 26) show the new pedestal indirect-lighting units now adopted at the base of the escalators at the Piccadilly Underground station. The diffusing glass trumpet with a "lily-like" appearance, which emerges from the surrounding



FIGS. 21 and 22.—Close-up views of lamps illuminating sign outside Watson House, showing the ease with which they may be drawn up to receive attention.

reflector, has a novel and decorative effect, helping to remove the impression of monotony which indirect lighting *per se* is apt to create.

Discussion

These varied contributions occupied most of the evening, and the time available for discussion was somewhat short. Mr. A. CUNNINGTON briefly discussed the lighting of the sign outside Watson House, enquiring whether the impression of a "cut-off" in illumination immediately under the sign, as apparent in the photograph shown at the meeting, really represented the effect obtained. He should have thought that the face of the building would receive some illumination.*

Mr. L. G. APPLEBEE expressed his interest in the account of the lighting of the Savoy Theatre, with which he had also been associated. He was therefore well aware of the special difficulties that had been successfully overcome by Professor Robertson and Mr. Ionides in order to achieve such a wonderful effect. It might be of interest to members of the Society to recall that the Savoy Theatre was the first in this country to utilize electric lighting—gas lighting, however, being also originally installed as a stand-by. Some information regarding the lighting of the stage at the Savoy Theatre, which had some novel features, might be of interest. In this connection Mr. Applebee drew attention to the flexibility and complete control effected by the special type of switchboard, a view of which was thrown upon the screen.

The CHAIRMAN, in winding up the discussion, proposed a vote of thanks to the various contributors, which was carried with acclamation. They were also very grateful to the London General Omnibus Co. Ltd., who had kindly arranged for one of the latest types of buses, embodying the new method of lighting described by Mr. Stallan, to be available outside the building for the inspection of members as they left.

* The effect illustrated in the view now shown on page 11 probably gives a better idea of the effect. In this view it is evident that the face of the building is also illuminated.—EDITOR.

FIG. 23.—One of the corridors in the new "Underground" building, showing indirect lighting.

FIG. 24.—Illustrating the lighting of counters by diffusing-glass luminous panels.

The Illuminating Engineering Society

(Founded in London, 1909).

ANNUAL DINNER

WEDNESDAY, FEBRUARY 12TH, 1930

The attention of members is invited to the **Annual Dinner,** to be followed by dancing, which has been arranged to take place on **Wednesday, February 12th, 1930.**

Dr. John W. T. Walsh, M.A., D.Sc., M.I.E.E. (President), will preside and a number of distinguished guests are expected to attend.

It is hoped that members will make a special effort to support the President and Council by their presence on this occasion, and bring with them, as guests, friends who are in sympathy with the aims and objects of the Society. Members may bring ladies as their guests.

The Dinner will be held in the **Prince's Galleries,** Piccadilly, London, W., and the price of the tickets will be **15s.** (exclusive of wine). The Dinner will commence at **7 for 7-30 p.m.,** and will terminate between 9 and 9-30 p.m., after which a hall will be available for dancing.

Members are requested to inform the Hon. Secretary regarding the number of tickets required and the names of any ladies or gentlemen they desire to invite as guests as soon as possible.

Twentieth Annual Exhibition of the Physical Society and the Optical Society

The above exhibition is to be held on Tuesday, Wednesday and Thursday, January 7th, 8th and 9th, 1930, at the Imperial College of Science, Imperial Institute Road, South Kensington, and will be open in the afternoon from 3 p.m. to 6 p.m., and in the evening from 7 p.m. to 10 p.m.

Over 80 firms have accepted the invitation to exhibit in the Trade Section at this exhibition. In addition a group of research and experimental exhibits is being arranged.

Discourses, with experiments, will be given at 8 p.m. on each evening, on the following subjects:—

JANUARY 7TH—The Right Hon. Lord Rayleigh, M.A., Sc.D., F.R.S.—"Iridescent Colours in Nature from the Standpoint of Physical Optics."

JANUARY 8TH — Mr. S. G. Brown, M.I.E.E., F.Inst.P., F.R.S.—"Gyro Compasses for Gunfire Control."

JANUARY 9TH—Sir Ambrose Fleming, M.A., D.Sc., F.R.S.—"Television, Present and Future."

With the object of encouraging craftsmanship in the scientific instrument trade, a section of the exhibition is to be devoted to the work of apprentices and learners.

Tickets are obtainable on application to the Secretary, the Physical and Optical Societies, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Tickets are required only on January 7th and 8th. Admission on the third day, January 9th, will be without ticket.

FIGS. 25 and 26.—Two views showing the novel pedestal indirect-lighting units in use in the Piccadilly Underground station.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society and is based on outside contributions.)

Electric Light and the Railway

By H. LINGARD

(E.L.M.A. Lighting Service Bureau.)

ALL boys who are "real boys" are interested in railways, and yet how few carry their enthusiasm into manhood! It is, of course, an English characteristic to grumble at any form of service, and our railways certainly come in for their share of criticism. Few realize, however, the amazing complexity of railway operation—how every detail is dovetailed in to form the complete system. From the lighting point of view, the railway is a small world of its own, demanding lighting treatments of nearly every conceivable kind, from the most advanced decorative lighting for the hotels and restaurants to the most utilitarian for the vital operation of signalling.

In common with all large undertakings it is not difficult to point to lighting faults on railways, but it should not be lost sight of that lighting progress on such a scale must, of necessity, be effected gradually, and while there are stations less than twelve miles from London where platforms are illuminated by oil lamps, there are others where the lighting leaves little for even the idealist to complain about.

Advertising.

Some of the best-lighted poster hoardings are to be seen at railway stations, and everyone must admit that the standard of art of modern railway posters makes them worthy of good lighting. The majority of these installations employ vitreous-enamelled angle reflectors, although floodlights are occasionally used, and it is noticeable that in most cases an adequate wattage is installed, giving emphasis to the board and making one wonder why such lighting is so rare on the ordinary sites where advertisers have to pay so heavily for their space.

The use of floodlight projectors for lighting shunting yards is now becoming quite common practice on British railways, and while this application is still to some extent in an experimental stage, the use of such high powered units undoubtedly makes the night shunters' task less hazardous, while on an equal intensity basis a floodlighting system should certainly prove more economical.

Architectural Lighting.

As I have indicated, decorative lighting is mainly confined to hotels and restaurants, leaving out of the question for the moment carriage lighting, which is somewhat of a subject in itself. There is little doubt that the future will see the extension of such lighting to vestibules, booking halls, and even perhaps to parts of the station buildings, particularly at terminal stations and in those where the traction is exclusively electric.

Industrial Lighting.

Running sheds, repair shops and loco works all call for the best that modern lighting can provide. In many cases, the ordinary range of industrial reflectors fulfils the lighting requirements for these purposes, but special systems of mounting are not infrequently required to counteract the effects of steam and smoke.

Rolling Stock.

In connection with the lighting of rolling stock it is interesting to note that the inside frosted lamp is being standardized on a number of railways, and this in itself will go a long way towards providing comfortable lighting for the convenience of the passenger—a very important point when it is borne in mind that the majority of passengers read during their journey.

Modern Overhead Lighting in a large Loco-erecting Shop.

Of late years there has been a decided tendency to depart from the central well-glass lighting unit in compartment coaches and to arrange the lamps so that an even distribution is obtained, enabling the passengers in the corner seats to read in equal comfort to those in the centre of the compartment.

Although at one time the practice in saloon coaches was to introduce rather elaborate metal fittings to carry lamps and shades, there is more of a tendency to-day to have a clean roof, free from all such encumbrances, with Pearl lamps mounted in well-designed holders close to the roof, providing general illumination, while decorative lighting is obtained from the locally controlled standards.

There appears to be no reason why in the future, at least in first-class saloons, built-in lighting on the architectural principle should not be adopted, and I believe in one or two of the Continental luxury trains such systems are already being tried out. Such lighting installed in coaches whose interior design was conceived on modernist functional lines would certainly create a great deal of public interest, and would be applicable to the famous long-distance trains of the various railway groups.

Signalling.

With reference to railway signalling, perhaps the latest development is the system using the light-sensitive cell, mounted in a complete unit on the locomotive and controlled from adjustable reflectors on the signal posts, which is at present undergoing tests on a section of the German State Railways. Referring to more orthodox electrical signalling devices, the day-colour-light signal is finding a steadily growing field of application and is replacing the semaphore system on many important sections, particularly where recent electrification has taken place. The use of such signals means that the driver obeys the same symbol, namely, coloured light day and night, and therefore the possibility of mistakes is reduced, while the greater compactness of the signals facilitates their mounting in awkward positions.

Light and Attraction.

As a system of transport there is little question that the railway is supreme, and although much has been spoken of the effect of road competition its effect is, I think, only a temporary one, influencing traffic receipts. On the other hand, in face of competition, the railway companies should not lose any opportunity to make their stations and approaches thoroughly attractive, and no easier method presents itself than that of adequate electric lighting. One so often hears in reference to a particular station that it is a gloomy depressing place, whereas a little expenditure on lighting, which is, after all, a very small amount in proportion to the other heavy installation costs which the railway companies are meeting daily, will provide an attractive and cheerful atmosphere, which should show itself very rapidly in a substantial increase in passenger traffic.

Football by Artificial Light

The note in our last issue regarding the floodlighting of the stadium at Newcastle, Pennsylvania, where an important football match was played by night, has brought us some correspondence. It is pointed out that the playing of football by artificial light in this country

is not exactly a novelty. The above illustration, for example, is a night photograph of a field taken on the occasion of a match between two teams of ladies at Preston as far back as 1924. The installation on that occasion was carried out by Messrs Siemens Electric Lamps and Supplies Ltd. by means of Benjamin parabolic and elliptical angle reflectors, arranged two on a pole, the upper reflector being parabolic and the lower of the elliptical type. A number of these poles were placed at each side of the ground and concentrating reflectors were mounted over the goal posts at each end. We understand that the players expressed great satisfaction with the lighting.

BOOKS by Leon Gaster and J. S. Dow

MODERN ILLUMINANTS AND ILLUMINATING ENGINEERING
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This book deals impartially with modern systems of lighting—gas, oil, electricity, and acetylene—and discusses their practical applications. A feature is the variety of illustrations, many of them reproduced from photographs taken entirely by artificial light. The new edition has been brought into conformity with the most modern practice, and forms a complete work of reference.

CONTENTS: History and Development of Methods of Illumination—Gas Lighting—Electric Lighting—Oil, Petrol-Air Gas, and Acetylene Lighting—Illumination and the Eye—Colour and the Eye—Measurement of Light and Illumination—Globes, Shades and Reflectors, and Calculations of Illumination—Problems in Interior Illumination—Outdoor Lighting—Searchlights and other Appliances for the Projection of Light—Index.

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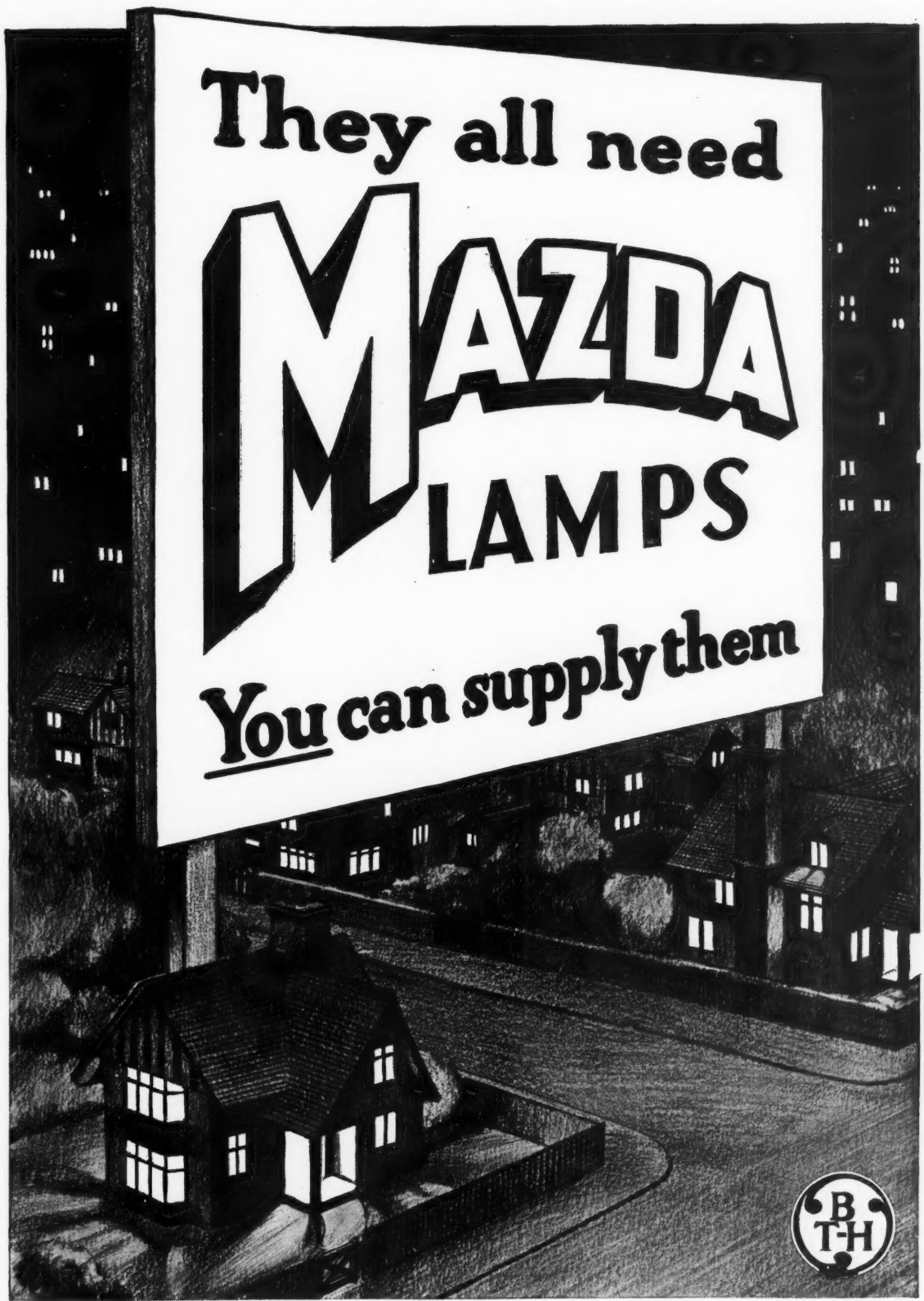
The Arc Light in Kinema Studio Work

Attention has frequently been drawn to the new conditions arising from the production of "talkie films" in kinema studios. For this work the high candle-power incandescent lamp has certain inherent advantages, but the necessity for a noiseless source is doubtless the main explanation why such lamps have been recently so widely used in this field. In many cases the arc light would still be preferred if a completely noiseless type could be contrived. We are assured, however, that owing to recent developments arc lamps are now likely to be adopted once more for many forms of kinema studio work.

Noise derived from such lamps, which is apt to be magnified by the microphone, may be due to spluttering and irregular action of the arc. This difficulty can be overcome by careful design and choice of carbons, though it is apt to give trouble in any but the best types of lamps. A more serious problem is the reproduction in the arc of relatively minute extraneous disturbances, such as those caused by the brush passing over sections of the commutator of the generator. Apparently this source of noise may now also be eliminated by the insertion in the circuit of the arc lamps of a special apparatus embodying a choker which damps down all these high-frequency ripples. In the course of a recent visit to the showrooms of Messrs Korting and Mathiesen Electrical Ltd. we were shown an apparatus of this type, and we understand that its use is making possible the reintroduction of arcs in a number of kinema studios.

The whole question of the lighting of studios for the preparation of films is in a state of constant development. Other considerations besides those mentioned above include the use of panchromatic films, and it is possible that the production of films exhibiting colours, which is now being actually studied, will also have a material influence on the choice of illuminants.



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The Lighting of the Bodleian Library, Oxford

THE oldest part of the Bodleian Library was built between 1450 and 1480 and contained the MSS. given to the University by Humphrey, Duke of Gloucester (d. 1447), but these were dispersed and destroyed in 1550 by the Commissioners of Edward VI. In 1598 Sir Thomas Bodley determined to furnish again Duke Humphrey's room with cases and books, and so became the founder of the Bodleian Library. In 1602 the library was formally opened with over 2,000 volumes, of which 299 were MSS. Ten years later the Arts end was added, and between 1613 and 1618 the third storey of the quadrangle was built with money provided for the purpose by Sir Thomas Bodley; this upper portion is now occupied by two reading-rooms and the picture gallery. In 1640 a room was built at the west end of the Duke Humphrey's Library, now called the Selden end. These three rooms and the third storey were sufficient for the purposes of the library until 1790, when it began its encroachment on the various rooms and schools of what is now the Bodleian Quadrangle.

Two views illustrating the lighting of the famous Bodleian Library, Oxford.

For over 300 years from its foundation in 1602 no artificial light of any kind was allowed to be introduced into the library, but in 1913 the use of electric torch-lamps was permitted for staff purposes. On account of this lack of artificial lighting, it was necessary in winter to close the reading-rooms at 3 p.m., which had always been a great inconvenience to scholars. The proposal to install the electric light into the Bodleian building was brought forward in 1926 and finally approved in the summer of 1929.

The contents of the Bodleian Library being of priceless value, quite irreplaceable and uninsurable, the most important point was to make the electrical installation perfectly safe, and also to convince the jealous guardians of this magnificent library that such could be done. A scheme has been devised by which no flexible cords are used. The highest quality electric lighting wires enclosed in steel tubing are used and are conveyed to every lampholder, whether they be of a portable fitting, pendant or other similar device. All switches, lampholders and fittings of all descriptions are metallically and electrically connected to the conduit, and the whole system carefully earthed at many points, so that in the event of any improbable damage to an insulated wire the only effect would be that the fuse protecting that circuit would "blow" and cut off the circuit from the supply until it was repaired. Under this system there is no possible chance of fire. This system has been carried out throughout the reading-rooms and the picture gallery, and very little conduit is visible, in spite of the fact that no walls have been chased and no tubing sunk or hidden anywhere except under the floorboards.

In the upper reading room and picture gallery, which are full of readers' desks and catalogue stands, as well as bookcases, two schemes were proposed:—

1. To light each individual reader's desk strongly and to provide a low general illumination.

2. To provide a general illumination of high intensity, and no local illumination at all.

After discussion it was decided that the latter arrangement was best, as it permitted the rearrangement of the desks, catalogue stands or bookcases without any alteration to the electric wiring.

After experimenting with many types of fittings, it was found that the Holophane reflector refractor fitting was the most suitable, both as regards illuminating effect and from an artistic point of view, and each of these rooms, which are 172 ft. long and 20 ft. wide, is illuminated with nine reflector refractor units (F902/2140) with 300-watt lamps. The illumination from these is approximately 7 foot-candles over the whole of the table surfaces, throughout the two galleries.

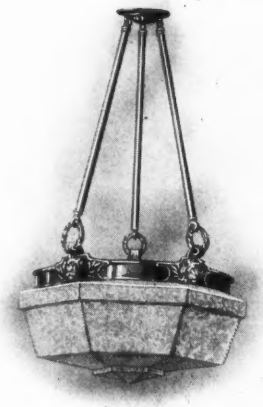
These fittings are unobtrusive by daylight, and the shape of the glassware and lines of the four supporting chains blend with the architectural features of the room. Each light is controlled by its own switch, the switches being grouped at the fuseboards and under the control of the janitor.

In the older part of the building, the Duke Humphrey's Library, with the Arts and Selden Arts, is treated in an entirely different manner. Here the ceiling is painted, and of great beauty. It was, therefore, decided that no work was to be done on these ceilings at all. At the same time their beauty required them to be shown up at night by illumination.

The final design evolved was to put standards with wooden columns and heavily frosted enclosed bowls upon the tops of the projecting bookcases in the Duke Humphrey's Library, and on the tops of the gallery rails at the two ends. The effect is very beautiful, the ceiling being lightly illuminated, and the floor area and bookcases also receiving a moderate general illumination.

The illumination, however, is not sufficient for the readers; therefore, in each alcove in the Duke Humphrey's Library short brackets are clipped to the bookshelves, with metallic reflectors, and certain of the desks in other parts of the old reading-room have standards also with metal reflectors; thus the readers' desks and staff desks are brightly illuminated, without the light straying from these lamps to the upper part of the library and spoiling the general illumination by strongly marked lines of shadow. The bookcases under the galleries are illuminated by a number of lamps with metal shades hidden under the mouldings.

The illumination and electrical specifications for this most interesting installation were prepared by Messrs. Dolby & Williamson, Consulting Engineers, of 8, Princes Street, Westminster, S.W.I, whilst the entire electrical work has been carried out by Messrs. Hill, Upton & Co., George Street, Oxford.



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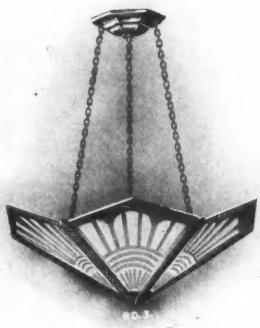

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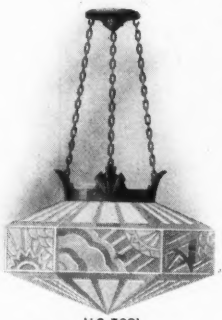

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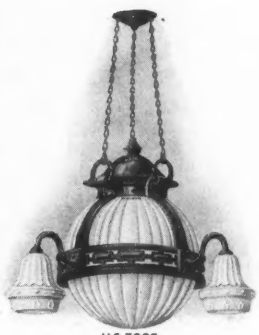

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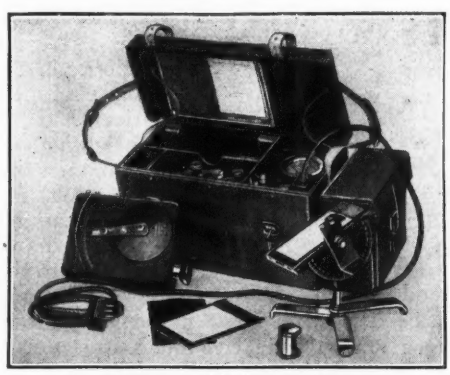

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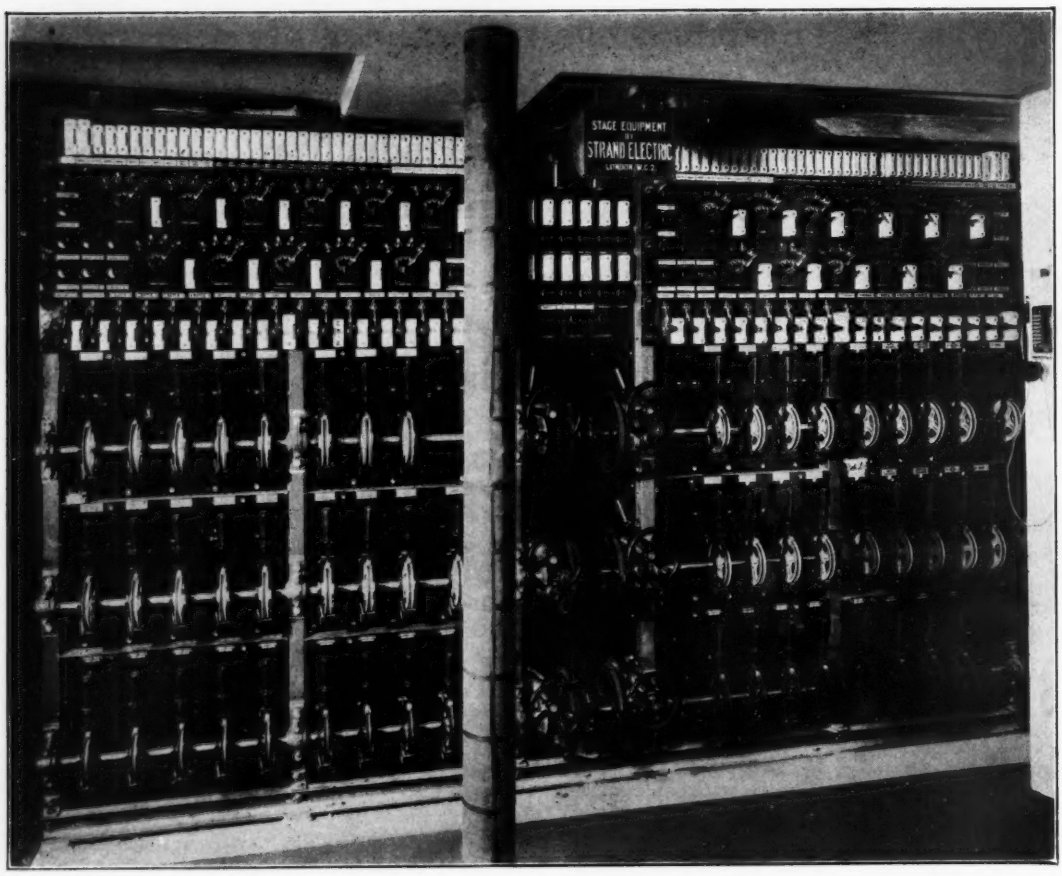
The Stage Lighting of the Savoy Theatre



WE reproduce above a view of the special stage switchboard installed at the Savoy Theatre, which was described by Mr. Applebee at the meeting of the Illuminating Engineering Society on December 10th, and which represents a distinct advance in this type of apparatus.

Some details of the stage lighting, as given by Mr. Applebee, may also be of interest. In addition to the ordinary four-colour standard footlight and batten lighting, a complete set of "Sunray" cyclorama lighting has been installed on a counterweighted bridge over the proscenium arch, whilst numerous "Seecol" 1,000-watt "spot" lanterns have been placed on the No. 1 batten on each proscenium, whilst wiring has been taken to many points in the auditorium, such as the front of the upper circle, so that spot lanterns can be placed there if required. Each of these lantern points has been fitted with a 1,000-watt "Sunset" dimmer, and the switching is so arranged that by means of a selector switch it can be transferred to any colour master.

Sheffield Illumination Society

PROGRAMME FOR 1930.

We have before us a copy of the programme of the Sheffield Illumination Society for 1930, in which, as usual, technical and social events are agreeably mingled.

The opening item on January 20th is a social evening at Stephenson's Restaurant, which will be followed on February 5th by "Office Notes" contributed by the Hon. Secretary, Mr. E. Marrison. On March 17th there will be a paper by Mr. E. Selwood entitled "Surveying," and "Storekeeping" will be dealt with by Mr. J. Whitehead on November 3rd. The annual meeting and presidential address are fixed for December 8th.

Visits have been arranged to the Vickers Works of the English Steel Corporation on May 7th, and to the glass works of the British Thomson-Houston Co. Ltd. on October 8th, and the annual outing takes place on June 21st. Finally we observe that the football team of the lighting department will enter the arena against the municipal officers on April 26th. We trust that illumination will win the day.

School Lighting

We notice in a recent issue of the *Kandem Quarterly Review*, published by Messrs. Korting & Mathiesen Electrical Ltd., a useful contribution dealing with school lighting. The author advocates that classroom illumination should be of the order of four to six foot-candles, whilst for drawing and sewing and in laboratories at least 5 foot-candles should be provided. Attention is drawn to the vital importance of avoidance of glare and to the problem of illuminating blackboards without troublesome direct reflections of lighting units in the more or less shiny surface. In elementary schoolrooms it is usual to rely on general lighting for the illumination of the blackboards, but in colleges more elaborate arrangements are practicable. Blackboards and diagrams may be illuminated by special local units placed quite near to them, and alternative subdued lighting may be provided, whilst pictures are being shown, in order that students may be able to take notes.

The article contains a number of diagrams and photographs illustrating the lighting of classrooms, etc., and some suggestions are given for the lighting of rooms containing shower baths by Kandem moisture-proof units.

THE SAVOY THEATRE LONDON

ENTIRE ELECTRICAL INSTALLATION

BY

STRAND ELECTRIC

ARNOLD BENNETT in the *Daily Mail*, Oct. 21st, 1929 :—

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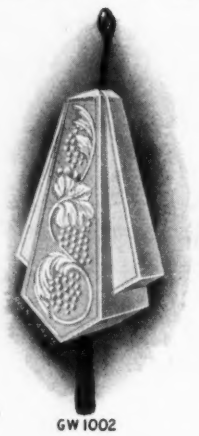
TRADE NOTES & ANNOUNCEMENTS

A NOVEL WALL FITTING.

Designs of wall fittings have changed considerably during the past few years, one popular "architectural" type being that built up geometrically from tapering diffusing glass plates. A fitting of this type, supplied by Messrs. Hailwood & Ackroyd Ltd., is here illustrated. This is provided with "Moon-Halo" glass, either satin-finished or tinted in "hot sun" (orange) or "peach" (pinkish) shades. This fitting is equipped with a silk hanging cord and tassel. It can be supplied with an aluminium back plate with lampholder. All that is necessary is to fasten the backplate to the wall and hang the glass wall box over the lamp. The size is 10 in. deep and 6 in. wide.



GW 1002

CO-OPERATIVE ENTERPRISE AT THE SAVOY THEATRE AND HOTEL.

The new lighting of the Savoy Theatre and Hotel, described by Professor H. Robertson and Mr. B. Ionides at the last meeting of the Illuminating Engineering Society, is a good example of co-operative effort. The charming and novel effect of the lighting reflects great credit on the architects, Messrs. Easton and Robertson, and on the consultant, Mr. William MacIntyre, but their success was also due to the skilful way in which special designs and apparatus were assembled from various firms. We understand that fittings were supplied by, amongst others, The General Electric Co. Ltd. and Messrs. Ascog Ltd., and that the Strand Electric and Engineering Co. Ltd. and the Engineers' Department of the Savoy Hotel were responsible for much of the wiring. Ingenious types of signs which figure in the Courtyard were furnished by the Strand & Interchangeable Signs Ltd. The Strand Electric & Engineering Co. Ltd. were also concerned with the stage lighting, a special feature of which was the novel type of switchboard described at the meeting of the Illuminating Engineering Society by Mr. L. H. Applebee.

THE LIGHTING OF T.S.S. "ORONTES."

The lighting of a large liner presents many interesting problems which have led to the design of fittings quite outside the ordinary range used for interiors on shore. Two dominant considerations are the motion of the vessel and, in many cases, limited space overhead. These have led to the use of fittings which can be attached rigidly to walls or ceiling and are compact and robust in design. We have before us several photographs illustrating the lighting of T.S.S. "Orontes" which we hope to reproduce shortly. The fittings utilized were designed and manufactured by Metro-Vick Supplies Ltd. to the requirements of Mr. A. N. Prentice, architect to the Orient Company. These are of simple but graceful design, a feature being the use of diffusing glass in octagonal lanterns with vertical lines of metal. We notice in the bulkhead fittings on the walls of the dining room a tendency to conform to the "architectural" style, the diffusing torch at the top resting on an inverted pyramid of diffusing glass.

We are also informed that the popular "Harcourt" fittings manufactured by the same firm have recently been installed in Chiltern Court, the large block of residential flats recently built over Baker St. station. Similar fittings are in use in the Sligo Cathedral, Ireland, the Bristol Art Gallery and numerous theatres, restaurants and places of entertainment.

CORRECT ARTIFICIAL LIGHTING.

The new catalogue recently issued by Benjamin Electric Ltd. under the above title is an imposing production comprising over 100 pages. Facing the "contents" is a full-page sketch of one of the heavy toggle-type drawing presses used in the manufacture of Benjamin "Crysteel" reflectors. A useful item is the series of hints on page 6 on the use of the catalogue. Pages 7-22 are devoted to hints on lighting, definitions, charts and tables of intensities, etc. An enterprising step, which strikes us as new, is the alphabetical list of different types of processes and interiors, and the type of fitting recommended for each. The remainder of the catalogue is devoted to particulars of various types of fittings. The series listed has been continually enlarged during recent years. The one-piece RLM., the Biflector and other standard types are familiar, but the "Visor" dust-proof protected reflectors are of quite recent introduction. Interspaced are reproductions in colour of various decorative types such as the "Bencolite" series, and there are numerous illustrations showing the actual effect in interiors of the fittings described.

PHILIPS LITERATURE.

We have received during the past month quite a number of specimens of literature issued by Phillips Lamps Ltd. for the Christmas season. The *Philips Announcer* for December contains particulars of suitable gifts and is executed in a popular and readable style. Attention is drawn to the new Philips demonstration van, the new Philips cabinet loudspeaker and other radio novelties. (We notice also a reference to the stimulating value of Argenta lamps in inducing chickens to lay more eggs during the winter!) Another enterprising production is the *Golden Jubilee Herald* issued by the Australian house. This contains a photograph of Mr. A. den Hartog (the Australian head) and views of the Melbourne office. On the back page there is a view of a section of the enormous lamp factory at Eindhoven and a photograph of the Philips football team, which has recently toured Europe with great success.

Amongst other notes from this firm we may mention an account of the new ceiling fitting (P.A. 16), which is made of 3-ply opal glass and is specially designed for use with Argenta lamps. This is selling at the very moderate price of half a crown.

CRYSELCO LAMPS

Yet another well-executed lamp list recently received is that issued by Cryselco Ltd. Particulars of all types of standard lamps are set out and an inset contains a series of night views showing the use of the opal variety at Waterloo station and elsewhere. Pages are executed with a blue border, and there is a striking coloured section illustrating the varied applications of Cryselco colour-sprayed and daylight blue lamps.

ENGINEERING & LIGHTING EQUIPMENT CO. LTD.

A Recent Purchase.

We are informed that the assets of the Pinnacle Switchgear & Fuse Co., Weybridge, were purchased by Messrs. Engineering & Lighting Equipment Co. Ltd. on November 14th, and that the business will henceforth be run in connection with the Sphere works at St. Albans.

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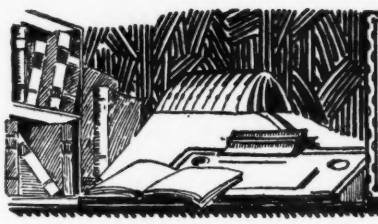

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

ELECTRIC STREET LIGHTING, *by C. J. Stahl.* (*Chapman & Hall, London,* 1929; *pp.* 228, *figs.* 128.)

This book is interesting as an example of the growing tendency towards dealing with specific aspects of illumination. The opening chapter is a readable survey of the historical development of street lighting, and its present condition. It is remarked that the average expenditure per capita on public lighting in American cities does not attain one dollar per head. Even in the United States progress was small during the war and in the subsequent period of financial stringency, though there have been active developments during recent years. Chapter II, which deals generally with the planning of public lighting, is interesting, and useful statistics illustrating American practice are given. We note a tendency to express results in lumens per linear foot of street. State Street, Chicago, with an allowance of 2,000 lumens per linear foot, heads the list, but main thoroughfares of many cities enjoy values from 500 lumens per foot upwards—which would be considered generous in this country. The author gives results in terms of average illumination, 1.3-3.0 foot-candles being mentioned for main business thoroughfares and values down to 0.05-0.1 foot-candles for highways (presumably rural). There is a useful discussion of architectural aspects illustrated by sketches of decorative posts and lanterns of the type familiar in the United States. From this point onwards the sequence of the chapters is somewhat unusual. In chapters IV to IX the author reverts to elementary information such as is usually found in general textbooks on illumination. Chapter X deals with street-lighting glassware. He returns again to this subject in Chapter XVIII, which deals with lanterns of the prismatic type. Intermediate chapters deal with calculations, isolux diagrams, estimation of uniformity factor, etc. Later chapters deal mainly with such matters as arrangement of circuits, current regulators, etc. Chapter XIX aims at summarizing the essentials of street-lighting, some interesting suggestions on methods of appraising the various factors being included. In Chapter XX, however, the author turns to incandescent and arc lamps, which one would have expected to be treated earlier. The book is useful as an indication of American methods, but it would perhaps have made a wider appeal if more attention had been paid to developments in other countries (apparently the British Standard Specification for Street-lighting is not discussed). One might also suggest that in a future edition fuller references to literature on street-lighting might well be included. At present such references are almost non-existent.

A TEXTBOOK ON ILLUMINATION, *by W. Kunerth, Ph.D.* (*Chapman & Hall, London,* 1929; *pp.* 269, *figs.* 118.)

This book, which is the outcome of a course in illuminating engineering arranged at the Iowa State College, is an addition to those of the textbook class, of which several have been issued in the United States within recent years. The general course of the treatment follows familiar lines and is in general up-to-date. The first chapter is devoted to a brief analysis of the nature of light and the chief laws of radiation. We observe that in a table of radiation classified in terms of wave-length (p. 3) a place is assigned to so-called "cosmic rays," which are apparently even shorter than those used in actinotherapy, but are nevertheless highly penetrative. A brief space is assigned to non-electric illuminants, after which electric lamps are treated in more detail. The author quotes the calculation that a black body at a temperature of 7000° K. would yield a spectrum with the maximum located at 0.555μ, about the centre of the visible spectrum, and would have a luminous efficiency of 43.5 per cent. It is also calculated that the cost of light is only about 5 per cent. of that prevailing in 1880. Subsquent chapters deal with photometry. The treatment of measurements of flux of light and mean spherical candle-power is unusually full. Representative illumination-photometers are also described, though these (unlike the laboratory photometers) are mainly of American type. Other sections deal with "Luminaires," "Brightness and Glare," "Direct and Indirect Lighting," "Light Projection" and "The Eye." The author is up to date in his description of such apparatus as the "reflectometers," devised for measuring brightness and reflecting power, and a form of "glarimeter," though we think that somewhat more precise rules for the avoidance of glare might have been formulated. The later chapters deal mainly with specific lighting problems, such as those involved in the illumination of streets, public buildings, residences, factories, etc. A series of problems is given at the end of each chapter, and the final series of 24 experiments outlined by the author should prove of interest to teachers of illuminating engineering.

INDEX (January, 1930).

EDITORIAL NOTES :—
Problems in Illuminating Engineering—Light during the Christmas Season—The Use of Spectacles in Very Fine Processes 1

NOTES AND NEWS ON ILLUMINATION 3

NEWS FROM ABROAD 4

TECHNICAL SECTION :—
Transactions of the Illuminating Engineering Society (Founded in London, 1909):
Account of General Meeting on December 10th ... 5
Problems in Illuminating Engineering 6
Announcement of Annual Dinner 14
Physical and Optical Societies: Joint Annual Exhibition 14

POPULAR AND TRADE SECTION :—
Electric Light and the Railway... 15
Football by Artificial Light 16
The Arc Light in Kinema Studio Work 16
The Lighting of the Bodleian Library, Oxford ... 18
Stage Lighting at the Savoy Theatre 20

TRADE NOTES AND ANNOUNCEMENTS 22

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED 23

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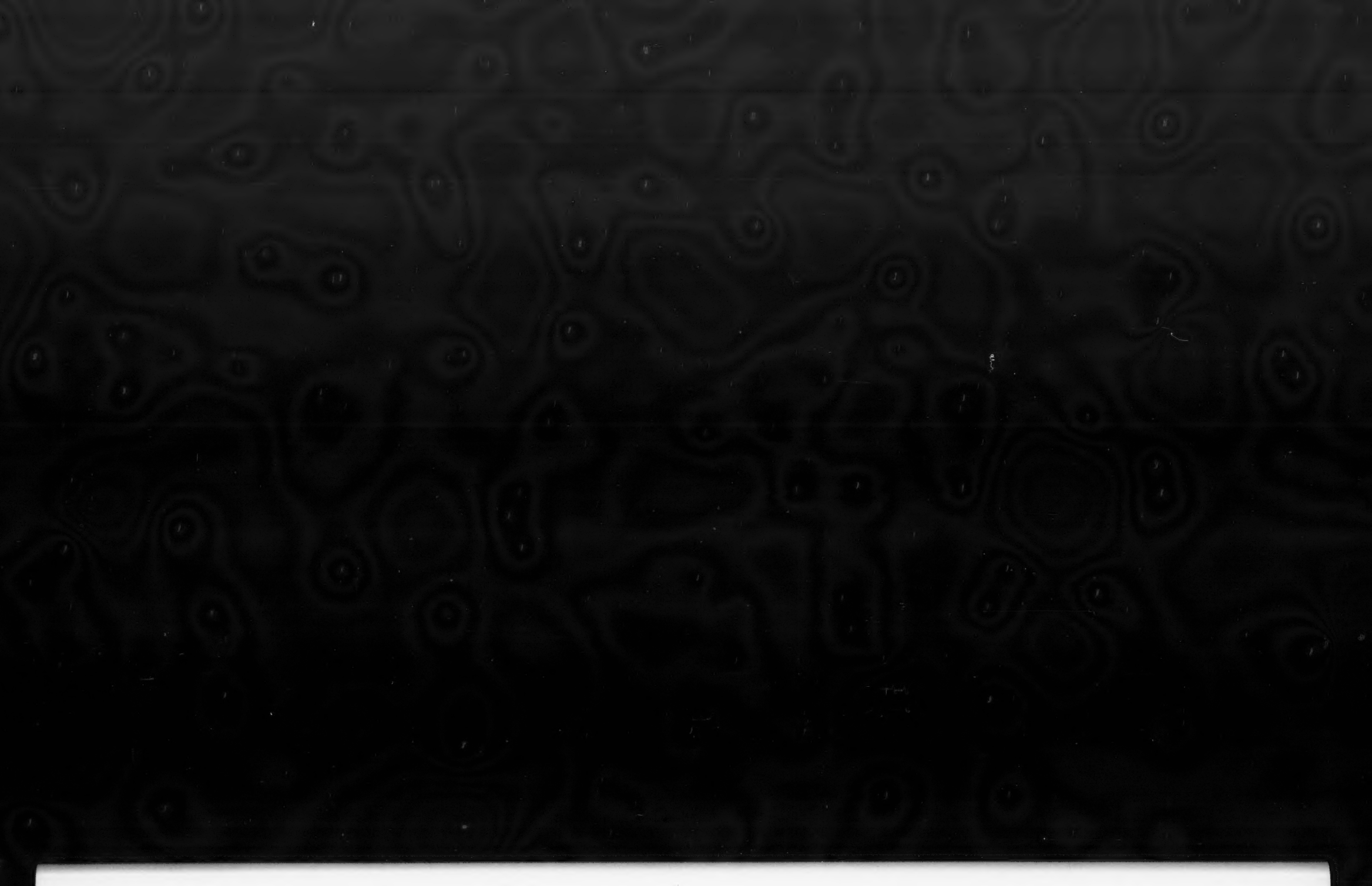
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